Exhibit 25

UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF TEXAS
HOUSTON DIVISION

In re: Anadarko Petroleum Corporation Securities Litigation	Case No. 4:20-cv-576 District Judge Charles R. Eskridge III CLASS ACTION

EXPERT REPORT OF DR. ROCCO DETOMO, JR.

January 25, 2023

CONFIDENTIAL

Exhibit
527

TABLE OF CONTENTS

Page

I. Background and Qualifications 1
II. Overview of Allegations 6
III. Summary of Findings and Opinions 7
  A. Summary of Opinions 7
  B. Summary of Rebuttal to Merrill's Opinions 12
  C. Summary of Rebuttal to Pittinger's Opinions 21
IV. Foundational Information 33
  A. General Exploration and Appraisal Process 33
  B. The Appraisal Process 37
    1. Key Appraisal Elements 37
    2. Estimating Stock Tank Oil Originally in Place – "STOOIP" 39
    3. Types of Exploration and Appraisal Wells 42
    4. Defining "Net Pay" 43
    5. Oil-Water Contacts 44
    6. "Deterministic" Versus "Probabilistic" Calculations 45
    7. Fluid Quality 47
    8. Gas-Oil Ratio 48
    9. Allochthonous and Autochthonous Salt 48
    10. Faults and Their Impact 49
    11. Fluid Pressure 51
  C. History of GOM Development 53
    1. GOM Development Chronology 56
    2. History of the Deepwater Lower Tertiary Play in the Gulf of Mexico 57
    3. Anadarko History in the Gulf of Mexico 59
  D. Primary Challenges to Appraisal in the Gulf of Mexico 60
    1. Salt and Seismic Imaging 61
    2. Unclear Views on the Hydrocarbon Migration Pathways and Filling Sequence 64
    3. High-pressure Environments and 20,000 psi Technology 67
  E. Technical Disputes at Shenandoah 71

1. Anadarko Exploration and Development Teams had Differing Missions 71

2. Anadarko Exploration and Development Teams had Differences in Mapping Techniques and Styles 73

3. Anadarko Exploration and Development Teams had Different Methodologies for Calculating Recoverable Volumes 74

4. Anadarko Exploration and Development Teams had Different Opinions of the Significance of Mapped Faults 75

5. Differences of Opinion Regarding the Shenandoah Appraisal Were Driven by Differing Objectives of the Exploration and Development Teams 77

V. Rebuttal to Merrill's and Pittinger's Foundational Information 79

A. Rebuttal to Merrill "Relevant Geological Background" 79

B. Rebuttal to Merrill's "Risk Assessments" 81

C. Rebuttal to Merrill "Resource Assessment" 82

D. Rebuttal to Pittinger "The Impact of Faulting" 86

E. Rebuttal to Pittinger "Appraising the Shenandoah Resource" 88

VI. The Shenandoah Appraisal Project 94

A. Pre-Shen-1 94

B. Shen-1 96

1. Well Results 96

2. Structure Mapping 97

3. Alleged Misstatements 98

4. Rebuttal to Pittinger Opinions re: Shen-1 106

C. Shen-2 108

1. Well Results 108

2. Structure Mapping 111

3. Alleged Misstatements 119

4. Rebuttal to Merrill Opinions re: Shen-2: 135

5. Rebuttal to Pittinger Opinions re: Shen-2 173

D. Shen-3 204

1. Well Results 204

2. Alleged Misstatements 209

3. Structure Mapping 243

4. Rebuttal to Merrill Opinions re: Shen-3: 249
5. Rebuttal to Pittinger Opinions re: Shen-3: 259

E. Shen-4 311
1. Well Results 311
2. Structure Mapping 317
3. Alleged Misstatements 327
4. Alleged Omissions 336
5. Rebuttal to Merrill Opinions re: Shen-4 340
6. Rebuttal to Pittinger's Opinions re: Shen-4: 356

F. Shen-5 422
1. Well Results 422
2. Structure Mapping 423
3. Alleged Misstatements 429
4. Rebuttal to Merrill Opinions re: Shen-5 435
5. Rebuttal to Pittinger's Opinions re: Shen-5 442

G. Shen-6 458
1. Well Results 458
2. Structure Mapping 462
3. Rebuttal to Merrill Opinions re: Shen-6: 467
4. Rebuttal to Pittinger Opinions re: Shen-6: 470

H. Rebuttal to Plaintiffs' Experts' Conclusions 477
1. Rebuttal to Merrill's Conclusions 477
2. Rebuttal to Pittinger's Conclusion 478

VII. Conclusion 480

Appendix 1 – Documents and Information Considered in My Report 482

Appendix 2 - Curriculum Vitae of Dr. Rocco Detomo, Jr. 497

Appendix 3 – Dr. Rocco Detomo Jr's List of Publications 502

Appendix 4 – Dr. Rocco Detomo Jr's Testimony in the last Four Years 504

TABLE OF FIGURES

Figure 1 – Probabilistic calculations for STOIIP. Each input has a range of possible values and a likelihood for each value. When they are multiplied together thousands of times with values weighted by their likelihood, a combined "Probability Distribution Function" (PDF) results. If one integrates this PDF, one will get the "Cumulative Probability" curve on the right that defines P90 and P10. Deterministically derived values for P90 and P10 are derived from specific models and typically occur at different points along the curve. 46

Figure 2 - A diagram of a "faulted horizon" where fluid contacts may or may not be at the same depth depending upon whether the fault is sealing or not. If the fault is non-sealing, the oil-water contact will be at the same level in both fault blocks. 50

Figure 3 – An example of how different fluids exert pressure along their fluid column height which is indicative of their densities. 51

Figure 4 - Principle of fluid contacts identification by using formation pressure surveys. This example shows two wells that do not cross the oil-water contact, with the contact position estimated from the pressure gradients intersection. 52

Figure 5 – Diagram showing how a sealing fault can give rise to different oil columns in each fault block but both fault blocks can still be in pressure communication with a common aquifer. This principle can be used to project an estimated OWCs for each fault block when no OWC has been penetrated with a well. 53

Figure 6 – Bathymetry map of deepwater Gulf of Mexico showing primary areas being explored in the Paleogene Plan (green) and Norphlet Play (blue). 55

Figure 7 – Idealized structural cross section showing prospects and discoveries in the Gulf of Mexico. 56

Figure 8 – The Shenandoah basin scaled to the size of a 6-foot-tall human. The vast majority of the column consists of sea water and salt that has covered the sedimentary deposits that make up the basin's reservoirs. 61

Figure 9 – Seismic image with interpretive overlay. The salt thickness (in brown) of 20,000 feet is referenced to Mt. Fuji which stands 12,388 feet high. The salt distribution is complex and contains imperfections and inclusions which distort the images of the sediment section underneath. 62

Figure 10 – Map showing the 2017 seismic coverage available over the Shenandoah discovery. 63

Figure 11 – Anadarko Exploration interpreted the oil at Shenandoah as having migrated from the deeper parts of the basin, filling all traps to their spill-point if enough charge was available. 65

Figure 12 - Model describing an oil charging method of "fill-and-spill" as oil migrates from the top and side and sequentially fills fault blocks from east to west. 67

Figure 13 - Formation pressures at the top of the Wilcox formation 68

Figure 14 – BOEM documentation of the number of deepwater wells drilled per year in the Gulf of Mexico color-coded by water depth. As shallower opportunities were depleted and as

technology advanced drilling and production capabilities, the ability to pursue deeper water targets increased. 69

Figure 15 - Comparison of Anadarko Exploration, Anadarko Development, and ConocoPhillips teams' mapped outline of Shenandoah top of Upper Wilcox. Anadarko's Exploration team has not interpreted faults where Anadarko Development and ConocoPhillips team have interpreted a variety of faults. However, each team has mapped a similar extent including the up-dip northern extent trapped by the salt, the extensive eastern area in trap, and similar OWCs that are minimally influenced by the possible faulting. 74

Figure 16 – A historical plot of Shenandoah P10/P90 volume assessment ratios by each partner over the appraisal process. Note fairly close independent assessments in the 2.0-to-6.0 range which is inconsistent with Merrill's assessment that these ranges should have been recognized as "too small." 84

Figure 17 – 2007 Anadarko Exploration Map in June 2007 for Shenandoah Prospect showing interpreted un-faulted structure and open blocks available in the upcoming Federal Lease Sale. 95

Figure 18 - Anadarko map of Shenandoah with comparison of partner trap outlines 96

Figure 19 - Anadarko Exploration's final map prior to drilling Shen-2. No faulting of the discovery is yet interpreted or expected by partnership, and continuity from Shen-1 to Shen-2 is projected for all reservoir sands. OWCs for the "E" sand is estimated from trap sealing capacity. 98

Figure 20 - A comparison of Shenandoah measured porosities versus other Lower Tertiary Wilcox discoveries demonstrating the significantly better reservoir encountered at Shen-1. 100

Figure 21 - Graph showing the improved porosity versus depth relationship expected at Shenandoah due to its "back-basin" location. 101

Figure 22 - Graph showing the improved permeability of Shenandoah and other "back-basin" opportunities. 102

Figure 23 – Society of Petroleum Engineers chart defining ranges of uncertainty for reserves, contingent resources and prospective resources, respectively. 104

Figure 24 – Cross section showing the Shen-1 and Shen-2 wells and the extremely encouraging ~1,000 net feet of oil in Upper and Lower Wilcox sands penetrated by the Shen-2 well. The total gross oil column was ~1700 feet tall – over twice as tall as Houston's TC Energy Center Tower. 110

Figure 25 – Anadarko Exploration map used for planning the Shen-3 appraisal well. This map shows the generally accepted east-west fault separating the Shen-1 discovery well from Shen-2. 112

Figure 26 – Venari mapping pre-Shen-3 appraisal well drilling. Venari interpreted a fault between the Shen-2 and planned Shen-3 locations, but also interpreted that fault as only extending as far south as the Shen-2 oil column is proven to fill. 113

Figure 27 – ConocoPhillips map of Shenandoah using structural dip attributes from the recently available "Coil" seismic data showing four potentially significant north-south interpreted faults. 114

Figure 28 – Anadarko Exploration pre-drill Shen-3 mapping with no faulting interpreted between Shen-2 and the planned Shen-3 location. The Shen-3 planned location is based upon being below Lowest Known Oil in Shen-2, and above the mapped reservoir spill depth, while testing the reservoir continuity to the east. 114

Figure 29 – Marathon map pre-drill for Shen-3 showing proposed appraisal location and no interpreted faults between there and Shen-2. 115

Figure 30 – Cobalt mapping pre-Shen-3 appraisal well (eastern circle). Cobalt has mapped faulting up-dip of Shen-2 (western circle) that separates it from Shen-1 (northern circle). However, no north-south faulting separating Shen-2 from Shen-3 is interpreted, and the Shen-3 appraisal location is targeting a location close to the mapped lowest possible trapped oil. 116

Figure 31 – Anadarko's Development Team mapping from before Shen-3 was completed, interpreting potential faulting and raising the possibility that Shen-2 may not be in a common fault block with Shen-3. 117

Figure 32 – Chart of 2010 crude oil price as a function of the oil's API (density) demonstrating the "premium" paid for "lighter" (higher API) oils, impacting a Development's economics.... 124

Figure 33 – Slide referred to in Plaintiffs' Amended Complaint referencing "900+ MMBOE Net Discovered Resources." 130

Figure 34 – Presentation slide cited by Plaintiffs referencing a "~$2 - $4 Billion Net Opportunity" for the Shenandoah basin. 134

Figure 35 – Mr. Rodriguez's map presented to Mr. Kleckner. 145

Figure 36 – Referenced north-south traverse through Shen-1, with Shen-2 and Shen-3 wells projected onto it. 155

Figure 37 – References map showing north-south traverse as vertical white line labeled N-S. The addition white lines to Shen-2 and Shen-3 show the location (along structural contour) to where these wells would project. 156

Figure 38 – Anadarko Seismic coherence map (or dip attribute map) created at the top of the Upper Wilcox sand. Note the discordance between mapped faults and mapped shaded areas in the northern part of the map where all appraisal drilling is located. 158

Figure 39 – Anadarko Exploration team Upper Wilcox seismic depth structure map from November 2014. Compare this map with the one he referenced earlier (*see* **Figure 37**, above), which shows the location of the same traverse but with the north-south fault included. 160

Figure 40 – Yucatan to Shenandoah Cross Section showing the faulting between Yucatan-1 and Yucatan-2 and between Shen-1 and Shen-2. 171

Figure 41 – Yucatan to Shenandoah Cross Section showing the faulting between Yucatan-1 and Yucatan-2 and between Shen-1 and Shen-2. 188

Figure 42 – Pittinger's Exhibit 16: Partner Structural Interpretations (Oudin 8/20/14). 193

Figure 43 – Pittinger's Exhibit 17: Structure Map with Lineaments (Oudin 8/20/14). 194

Figure 44 – Anadarko Exploration isopach of Lower Wilcox before drilling of Shen-3 well showing thinning of reservoir sands up-dip. 200

Figure 45 – Anadarko Exploration isopach of Upper Wilcox before drilling of Shen-3 well showing thinning of reservoir sands up-dip. 200

Figure 46 – Anadarko post-Shen-3 oil distribution maps with estimated OWCs based upon projected pressures from Shen-2 oil column and Shen-3 water column. Projecting the same OWC on both sides of the interpreted fault implies that the oil column on each side is not only in pressure contact with the aquifer, but that oil has equalized across the fault and that the fault is interpreted as non-sealing. 207

Figure 47 – A comparison of Upper Wilcox oil sands extent by partner at Shenandoah before the drilling of the Shen-4 well. Maps demonstrate very similar views to the east. Western differences are based upon uncertainty in base of the allochthonous salt. Volumetric differences between companies are also being driven by estimated variations in recovery efficiencies (14%-28%). Note that the projected down-dip OWC is estimated similarly by all partners and is common across any interpreted faults. 209

Figure 48 – Example of turbidite depositional model indicating how the wells at different locations help to define where in the depositional system one is exploring and giving indications of what reservoir continuity one should expect. 213

Figure 49 – Classic turbidite depositional model demonstrating the distribution of sand and shale facies that one might expect depending where one is located within the system. There is strong lateral sand continuity in the downdip direction and within the major components of each fan. 221

Figure 50 – Figure demonstrating how one might consider classifying resource volumes as proved, probable, or possible using pressure in two wells in pressure communication with each other and projecting estimated OWCs. 225

Figure 51 – Anadarko Exploration pre-drill Shen-3 mapping where the Shen-3 planned location is based upon being below Lowest Known Oil in Shen-2, and being just above the mapped reservoir spill depth, while testing the reservoir continuity to the east. 227

Figure 52 – Diagram showing how a sealing fault can give rise to different oil columns in each fault block but both fault blocks can still be in pressure communication with a common aquifer. Well "A" is Shen-2 and Well "C" is Shen-3. This principle can be used to project an estimated OWCs for each fault block when no OWC has been penetrated with a well. 228

Figure 53 – Anadarko Exploration mapping post Shen-3 appraisal well. Anadarko Exploration updated their maps indicating a north-south set of faults that separate the oil reservoir in the Shen-2 appraisal well from the area up-dip of the Shen-3 appraisal. However, they carried a common projected OWC based upon pressures across these faults that indicates an interpretation of communication across the faults. 229

Figure 54 – Comparison of Anadarko Development team's seismic dip map and its interpreted structural map with faulting after Shen-3 appraisal well. Note that all the drilled wells (in green) are in poorly imaged areas. (Future possible appraisal well sites are in red.) 234

Figure 55 – Shenandoah dip map where darker zones indicate areas where there is an "inflection" in the seismically mapped structural horizon. These "inflections" were then interpreted as potential faults. Note the poor character of this attribute in the up-dip area of the appraisal wells (red dots) and oil reservoir (red outline). 243

Figure 56 – Anadarko Exploration mapping prior to Shen-4 appraisal well spud. Anadarko Exploration had updated their maps indicating a north-south set of faults that separate the oil reservoir in the Shen-2 appraisal well from the area up-dip of the Shen-3 appraisal. Note that Shen-4 is a planned deviated hole up-dip. 244

Figure 57 – Anadarko's Development team mapping post-Shen-3 maintaining the same significant faulting pattern interpreted from before Shen-3 results and still recognizing the possibility that Shen-2 oil may not be in a common fault block with Shen-3. The "red dots" are potential future well locations..... 245

Figure 58 – ConocoPhillips map post-Shen-3 and before spud of Shen-4 (shown in red). ConocoPhillips maintained the same major faults in their interpretation from before Shen-3. . 246

Figure 59 – Cobalt map post-Shen-3 and before spud of Shen-4 indicating north-south faulting although different from other partners. 246

Figure 60 – Venari map post-Shen-3 and before spud of Shen-4 indicating north-south faulting also different from other partners. Triangles are potential appraisal locations..... 247

Figure 61 – Marathon map post-Shen-3 and before spud of Shen-4 indicating north-south faulting which is similar but different from other partners. Marathon maps the prospect as three different fault blocks (west, central, east) with a common OWC across all blocks. 248

Figure 62 – A schematic of the types of geologic structures that can be determined with different tools. Core and borehole imaging tools are excellent in characterizing small scale geologic structures, but large-scale faulting requires confirmation via seismic mapping..... 259

Figure 63 – Anadarko Exploration isopach of Lower Wilcox before drilling of Shen-3 well showing thinning of reservoir sands up-dip..... 264

Figure 64 – Anadarko Exploration isopach Lower Wilcox after drilling of Shen-3 well showing continued thinning of reservoir sands up-dip. Changes in the thickness contouring represent updates in net sand laterally based upon well data. 264

Figure 65 – Anadarko Exploration isopach of Upper Wilcox before drilling of Shen-3 well showing thinning of reservoir sands up-dip..... 265

Figure 66 – Anadarko Exploration isopach Upper Wilcox after drilling of Shen-3 well showing continued thinning of reservoir sands up-dip. Changes in the thickness contouring represent updates in net sand laterally based upon well data. 265

Figure 67 – Early ConocoPhillips structure map showing extensive east-west faulting shown by Pittinger as Exhibit 10. ConocoPhillips soon replaced this map with one showing no east-west faulting and interpreted four north-south faults instead..... 271

Figure 68 – Anadarko's Development team mapping indicating significant interpreted faulting and showing both the proposed Shen-F location (drilled as Shen-4) and the Shen-B location. Development was concerned about east-west faulting down-dip of the "F" location. Development was wrong as this fault did not exist and this whole up-dip region was salt..... 280

Figure 69 – Comparison of Partner's Structural Maps. 291

Figure 70 – Preliminary Cross-section of Shen-2 to Shen-2 sent by Mr. Trautman..... 297

Figure 71 – Pittinger's Exhibit 50 showing net pay results. 300

Figure 72 – Anadarko Exploration isopach Lower Wilcox after drilling of Shen-3 well showing continued thinning of reservoir sands up-dip. Changes in the thickness contouring represent updates in net sand laterally based upon well data. 301

Figure 73 - Anadarko Exploration isopach Upper Wilcox after drilling of Shen-3 well showing continued thinning of reservoir sands up-dip. Changes in the thickness contouring represent updates in net sand laterally based upon well data. 302

Figure 74 – Keys to improving the Shenandoah economics.. 308

Figure 75 – Anadarko Exploration mapping after Shen-4 encountered salt............................ 318

Figure 76 – Anadarko Exploration mapping after Shen-4 ST1 encountered 622 net feet of pay in Lower Wilcox sands. 318

Figure 77 – Anadarko Exploration mapping after Shen-4 ST1 MDT measured pressures indicated that this was not connected to Shen-2 and that the OWC in this fault block was deeper than that at Shen-2, giving rise to an interpreted fault between them....................................... 319

Figure 78 – Top sand map from ConocoPhillips post Shen-4 ST1 BP (October 2015). Note that the estimated OWCs in each fault block (except Shen-1). 320

Figure 79 – January updates to Anadarko's Exploration mapping methodology post Shen-4. 321

Figure 80 – Anadarko Development structure map presented at March 2016 Partners' Meeting. The major structural fault elements are consistent with both Anadarko Exploration and partner interpretations. 322

Figure 81 – Cobalt map post-Shen-4 ST1 and BP but before drilling Shen-5 at "E" location (in yellow). 323

Figure 82 – Marathon map post-Shen-4/ST1/BP before drilling Shen-5 at "E" location (in purple). Marathon's faults are positioned differently but have similar predicted effects on connectivity... 324

Figure 83 – Venari map post-Shen-4/ST1/BP before drilling Shen-5 at "#5" location. Venari's faults are in close agreement with Anadarko's and ConocoPhillips' fault interpretations......... 325

Figure 84 – A May 3, 2016 comparison of Anadarko mapped faulting with partner mapped faulting showing 75%-100% agreement in the interpreted location of the faults across the partnership before the drilling of Shen-5. 326

Figure 85 – Anadarko Development reservoir modeling post Shen-4/ST1 appraisal well indicating that differing oil pressures in Shen-4 ST1 and Shen-2 must indicate a fault separating the oil columns. However, the interpretation of a common downdip aquifer allowed Anadarko Development to continue to use pressures in Shen-3 to project OWCs in each fault block across the basin. 327

Figure 86 – Graphic indicating that deeper salt overrode the Lower Tertiary sediments burying them beneath a thick canopy of shallower salt. 337

Figure 87 – Shenandoah map showing relative positions of Shenandoah appraisal drilling including the Shen-4 test at the western up-dip limits of the basin. 338

Figure 88 – Cross-section that was shown that clearly indicates that the original Shen-4 well drilled into salt. 340

Figure 89 – Comparison of Anadarko Development team maps from before Shen-4 (top) and after Shen-4 (bottom). Note the changes in the faulting in the northwest area. 346

Figure 90 – Pittinger's Exhibit 27: Negative Results of Shen-4 Impact.................................. 361

Figure 91 – Exploration Overview presentation from November 3, 2015 outlining the reservoir quality net pay values from Shen-4 ST1... 364

Figure 92 – Reference Case for Fluid-in-Place by Fault Block and by Reservoir calculated by Mr. Shotts and Ms. Frye shown in March 2016 Partner Subsurface Meeting........................... 371

Figure 93 – Pittinger's Table comparing post-Shen-4 ST1 Volume Assessment inputs between Anadarko Exploration and Development teams. 386

Figure 94 – Anadarko Development team's comparison to Gulf of Mexico's top ten fields with their estimate of P10-P50-P90 of 717.4 - 350.3 - 223.5MMBOE, respectively........................ 388

Figure 95 – Intervention estimates from Ms. Frye and Ms. Prosser. The "Coiled Tubing Cleanouts" are specifically for addressing asphaltene dropout. 398

Figure 96 – The overall agenda for the Strategy Development Meeting that tested numerous portfolio strategies. 418

Figure 97 – Pittinger's Exhibit 78: Key Play Statistics. 419

Figure 98 – Anadarko Development structure map after Shen-5 was drilled. There were no significant structural changes to the map other than the projected OWCs for the eastern fault block (Shen-5 and Shen-3) moved approximately 200 feet shallower by projecting from oil pressures in Shen-5 and water pressures in Shen-3. 424

Figure 99 – ConocoPhillips' map after the Shen-5 well was drilled. ConocoPhillips made no effective structural changes to their maps other than to adjust the projected OWCs to the east based upon oil pressures in Shen-5.. 425

Figure 100 – Development structure map showing estimated OWCs that follow consistent contours across many of the faults and projected OWCs using oil pressures from one fault block with water pressures from another fault block, both of which demonstrate an interpretation of a common downdip aquifer. 427

Figure 101 – Anadarko Development Post-Shen-5 map indicating HKW, LKO, and estimated OWCs for each fault block. OWCs are mapped using Shen-3 water pressures and the oil pressures from each individual fault block. 428

Figure 102 – ConocoPhillips' post-Shen-5 map with estimated OWCs.................................. 429

Figure 103 – Slide from the May 24, 2016 UBS Global Oil and Gas Conference showing each of the Shenandoah appraisal wells including the still-drilling Shen-5 well and the future Shen-6 well... 433

Figure 104 – A plot of porosity values from Shen-4 ST1 and Shen-4 ST1 BP as a function of depth demonstrating the high porosity value preserved in the Wilcox reservoir sands............. 434

Figure 105 – May 24, 2016 Presentation slide showing status of the Shenandoah appraisal and clearly indicating the fault blocks to investors. 441

Figure 106 – The Shen-5 Oil Pressures. Unique gradients are measured for 7 zones – (UW1, UW2 upper and lower, UW3 upper, UW3 middle, UW3 lower, UWA upper and lower, and UWB). 445

Figure 107 – Shenandoah Fluid Property Summary tabulated in September 2016 after lab measurement from Shen-5 well. 447

Figure 108 – September 2016 slide demonstrating planned development activities and progress for Shenandoah field. 457

Figure 109 – September 2016 slide illustrating Anadarko's continued efforts for reaching sanction for Shenandoah field development. 458

Figure 110 – Post Shen-6 structure map (October 2017) from Anadarko Development with a newly interpreted fault separating Shen-5 from Shen-6. This fault had been unrecognized by the partnership in their pre-Shen-6 maps. 463

Figure 111 – ConocoPhillips' post Shen-6 structure map (October 2017) also indicating additional faulting with developable volumes limited to the Shen-2, Shen-5, and Shen-4 fault blocks. 463

Figure 112 – Venari Post Shen-6 structure map (July 2017) also indicating additional faulting between the Shen-5 and Shen-6 wells. The projected OWCs for fault blocks Shen-2 and Shen-5 (light blue) are estimated by projecting from Shen-6/Shen-3 water pressures. 464

Figure 113 – Anadarko Development map after Shen-6 indicating updated OWCs. The wet Shen-6 and sidetrack indicated that Shen-5 and Shen-6 were not connected in the oil column. Note that all estimated OWCs from Shen-4 ST1 to the east are calculated using water pressures from Shen-3 465

Figure 114 – Anadarko Development map after Shen-6 well indicating producible compartments and potential development well locations. Faults define oil compartments that are expected to produce differently. However, estimated OWCs are still calculated under the interpretation of a common downdip aquifer in pressure communication with Shen-3 well. 465

Figure 115 – Anadarko Development remaining developable fault blocks post-Shen-6 appraisal with remaining uncertainly on the location of OWCs for each fault block. 466

I, Dr. Rocco Detomo, Jr., pursuant to 28 U.S.C. § 1746, hereby declare under penalty of perjury that this Report, and the attached copy of my CV and list of materials relied upon for this Report, are true to the best of my knowledge, information, and belief.

I. BACKGROUND AND QUALIFICATIONS

1. I am a geoscientist with over 40 years' experience working in all aspects of deepwater exploration, appraisal, and development projects.

2. I began my working career as a geoscientist in 1981 with Shell Oil Company ("Shell") in Houston after receiving my B.Sc./M.Sc. in physics from the Ohio State University and then receiving a Ph.D. in experimental nuclear physics. In total, I worked for Shell for 33 years.

3. From 1981 until 1991, I served as the Geophysical Supervisor for Land Acquisition and Seismic Processing for Shell Western United States in Houston, Texas. During this period, I became a leading expert in collecting signals from geophones, velocity meters, and accelerometers, and in processing those signals through a variety of signal processing algorithms using computers. Over the course of my career, I have been involved in hundreds of data acquisition surveys, including dozens of seafloor surveys utilizing ocean bottom technologies, and numerous wellbore technology surveys using a variety of acoustic, electric, magnetic, gravity, and fiber optics sensors.

4. From 1991 until 2005, I was in New Orleans working for Shell Exploration and Production in the Gulf of Mexico, drilling wells in the redevelopment of shallow water oil and gas fields, managing the development of Shell's first subsalt oil and gas field, and serving as Development Manager for an offshore satellite platform.

5. In 2005, I returned to Houston to lead Shell's Global Deepwater Exploration Capability Deployment in Quantitative Integrated Evaluation team, and to serve as Shell's Gulf of Mexico Exploration Seismic Manager.

6. In 2008, I moved to Lagos, Nigeria to serve as Shell's Head of Reservoir Geophysics/Quantitative Interpretation in Sub-Saharan Africa, where I was involved with monitoring equipment, wells, and reservoirs across both onshore and offshore environments, including the appraisal and development of offshore deepwater fields.

7. In 2012, I returned to Shell's Houston Research Center to lead research in reservoir surveillance and time-lapse monitoring. During this time, I led research teams in Houston and the Netherlands regarding use of novel sensors, including fiber optics equipment, to monitor onshore and deepwater reservoirs and the surrounding subsurface continuously in response to hydrocarbon production, water, and steam injection.

8. I retired from Shell in 2014 and founded OMOTED Geophysical Consulting, LLC where I serve as CEO and provide geophysical consulting services and educational training to individuals and companies in the oil and gas industry, including with respect to data acquisition survey design, signal processing, interpretation, and geophysical training, with an emphasis on time-lapse monitoring. I also advise on exploration evaluation and prospect risking as well as integrated subsurface evaluation.

9. I am the recipient of the Houston Geological Society 1997 Best Paper of the Year and co-recipient of the 1997 A.I. Levorsen Award for GCAGS Best Paper. During my 40 years as a member of the Society of Exploration Geophysicists (SEG), I was president of the Southeastern Geophysical Society; I was the Technical Program Chairman for the 2006 and 2015 SEG annual meetings; and I was the Chairman of the SEG Travel Grants Committee, the SEG Distinguished Lecturers Committee, the Development & Production Committee, and the EVOLVE Committee.

10. In 2012, the SEG selected me as the Middle East & Africa Regional Honorary Lecturer, for which I delivered 28 lectures across the region on seismic reservoir monitoring and the use of ocean bottom node (OBN) sensors. From 2012 to 2015, I sat on the Board of Directors of the SEG, and I am currently serving as a Trustee Associate and member of the Board of Directors for the SEG Foundation. I am also a member of the European Association of Geoscientists & Engineers (EAGE), American Physical Society (APS), and the scientific research honor society Sigma Xi.

11. During my time working at Shell, I had roles on over 20 major deepwater Gulf of Mexico exploration, appraisal, and development projects totaling over 100 wells drilled, including:

- Redevelopment Subsurface Lead for the Shelf South Pass 62 and 70 fields.
- Lead for appraisal and development of subsalt the Enchilada and Salsa discoveries and developments.
- Subsurface Lead in discovery and appraisal of the Conger field.
- Offshore Development Manager for the Cinnamon field.
- Deepwater Advisor and Decision Board Member leading to tertiary development at the Perdido field.
- Deepwater Advisor for appraisal and development options at the Stones Lower Wilcox Tertiary development.
- Exploration Seismic Manager for 2005, 2006 and 2007 Gulf of Mexico federal lease sales.
- Exploration Lease Sale Evaluation Team that led to the Norphlet discovery and development in the Eastern Gulf of Mexico.
- Lead for Shell's Exploration Risking Team and Global Technical Authority in Deepwater Subsurface Evaluation from 1999 to 2008, and
- Manager for Deepwater Reservoir Monitoring Team for global assets

12. In the past ten years, I have authored ten published documents, as described further in my list of publications that is attached hereto as Appendix 3.

13. In the past four years, I have provided expert deposition testimony in one case: *Magseis FF LLC, et al. v. Seabed Geosolutions (US) Inc., et al.*, No. 4:17-cv-01458 (S.D. Tex.). I have not provided trial testimony as an expert in the prior four years.

14. I am being compensated at the rate of $600 per hour for my work on this matter, including for my report and testimony. My compensation is not dependent on the opinions I formed or the outcome of this matter.

15. I have been retained by Defendants' counsel in this case as an independent expert witness to provide my opinions regarding Anadarko's appraisal of the Shenandoah prospect and its public statements related thereto. I have also been asked to review and respond to the expert reports of Dr. Robert Merrill and Mr. Lyndon Pittinger and all accompanying exhibits to those filings, as well as the deposition transcripts for Merrill and Pittinger, held on December 7 and December 16, 2022, respectively.

16. My consideration of the issues in this matter is ongoing. I may consider additional produced documents, information, testimony, or exhibits arising from further proceedings, including any reports or testimony from Plaintiffs' experts. I reserve the right to supplement this report based on any such information and analysis and to provide additional materials that summarize, support, or explain my opinions. I reserve the right to expand on the opinions expressed in this report.

17. In this report, I assess both the results of the Shenandoah appraisal project and the opinions of Plaintiffs' experts, Merrill and Pittinger. While I do not address every statement made by Plaintiffs' experts, I address the key topics they discuss and most aspects of their assessments. The decision not to address a statement made by Plaintiffs should not be interpreted as agreement with that statement.

18. The materials that I have considered as part of my review are included in Appendix 1. My *curriculum vitae* is included with this Report as Appendix 2. My list of publications is included with this Report as Appendix 3.

II. Overview of Allegations

19. I understand that this case concerns the appraisal of the Shenandoah prospect. The Shenandoah prospect is one of several prospects in the Shenandoah sedimentary basin, commonly referred to as the "Shenandoah basin" or "Shenandoah mini-basin." The Shenandoah prospect was identified through seismic surveys as a potential source of commercially producible hydrocarbons in 2006, and Anadarko and a group of other companies (the "partners" or the "Shenandoah partners") spud an exploratory well, the "Shenandoah-1" well ("Shen-1"), in 2008. After Shen-1 found approximately 300 feet of oil pay, the partners commenced the appraisal of the Shenandoah prospect in approximately 2012 with the drilling of the "Shenandoah-2" well ("Shen-2"). They continued with the appraisal program until 2017, drilling four additional appraisal wells, the "Shenandoah-3" well ("Shen-3"), the "Shenandoah-4" well ("Shen-4"), the "Shenandoah-5" well ("Shen-5"), and the "Shenandoah-6" well ("Shen-6"). Although membership in the partnership changed over time, for much of the Class Period (defined as February 20, 2015 through May 2, 2017), the partners included Anadarko, ConocoPhillips, Venari, Cobalt and Marathon.

20. On May 2, 2017, after receiving the results of Shen-6, Anadarko announced that it was suspending the Shenandoah appraisal program, writing off $435 million in suspended exploratory well costs, and taking a $467 million impairment related to the prospect.

21. I understand Plaintiffs allege that Anadarko inflated the public's understanding of the Shenandoah prospect prior to the start of the Class Period and made misleading statements to investors during the Class Period regarding the commerciality of Shenandoah. Specifically, I understand Plaintiffs to be alleging that Defendants concealed negative information about the prospect and overstated the viability of Shenandoah.

III. Summary of Findings and Opinions

22. In this section, I begin with a summary of the key opinions in my report. I then address the opinions from Dr. Merrill and Mr. Pittinger's reports, respectively.

A. Summary of Opinions

23. Based on my experience and my analysis of the materials described in Appendix 1, a summary of my findings and opinions with respect to this matter are as follows:

24. Shenandoah had tremendous potential to be a large, commercially productive field. The depositional environment of its Lower Tertiary deepwater turbidite sands is of exceptional quality. More specifically, the high quality oils trapped in its deepwater subsalt basin made Shenandoah a promising opportunity in an emerging high-pressure deepwater Gulf of Mexico play. The Shen-2 well proved a hydrocarbon column of over 1,000 feet of stacked reservoir sands and was an exciting result for Anadarko and its partners.

25. There was significant uncertainty at Shenandoah before, during, and after the Class Period. The combination of poor subsalt seismic imaging and sparse appraisal well information created uncertainty about the characteristics and areal extent of the Shenandoah prospect, including the amount of potential faulting. These challenges and uncertainties are well known in the oil and gas industry. However, as a result of additional appraisal drilling and seismic reprocessing during the Class Period, there came to be relative consensus among Anadarko and the partnership that north-south faulting divided the prospect into oil-separated fault blocks. Anadarko and the partners accounted for the possibility that unidentified small-scale faulting would impact hydrocarbon recovery by predicting lower recovery factors than a laterally connected reservoir would deliver. The partners assumed aquifer support from the basin center, but could not prove this unless and until the field was put into production.

26. The purpose of the appraisal process is to gain a better understanding of the characteristics and size of a reservoir, to reduce uncertainty, and to ultimately conclude if producing the reservoir can be economically profitable. In appraising a prospect, exploration and development teams have fundamentally different goals, with exploration teams focused on determining, for any particular prospect, how big it could be, and development teams focused on determining whether the uncertainties of a project have been reduced sufficiently to state with confidence that the project has reached a size necessary for the company to invest in development.

27. During the Shenandoah project, there were technical disagreements between Anadarko's two appraisal teams, Exploration and Development, as well as between Anadarko and the partners. Technical disagreements are common in deepwater exploration and appraisal projects, particularly given the extent of uncertainty. Here, the disputes between Anadarko's Exploration and Development teams regarding the Shenandoah project were the result of the teams having different missions, objectives, mapping techniques and styles, opinions regarding the significance of mapped faults, and methodologies for calculating resource ranges.

28. Plaintiffs' experts, Pittinger and Merrill, who were tasked with opining on the "adverse information" known to Defendants "about Shen's commercial viability and producible resource size" "leading up to and during the Class Period,"[1] criticize Anadarko for having optimistic internal resource estimates and inaccurate internal maps, and suggest that Anadarko ignored negative information. Plaintiffs' experts overstate the risk and negative implications of these issues. For instance, Plaintiffs' experts place significant emphasis on the occurrence of asphaltenes in the Shenandoah oils as a negative factor in the field's commercialization. However, these are not unusual in deepwater Gulf of Mexico, and Anadarko and other operators have

[1] Expert Report of Robert Merrill ¶ 3; Expert Report of Lyndon Pittinger ¶ 3.

extensive experience in dealing with this issue. In this case, Anadarko had a development plan that specifically accounted for mitigation of potential asphaltene consequences and operational costs dedicated to interventions.

29. Plaintiffs' experts are critical of the quality of technical work performed by Anadarko's Exploration and Development staff, but the evidence supports that these staff worked with integrity and significant technical abilities. They also engaged regularly with their technical counterparts at partner companies, including for example ConocoPhillips, whose project manager Dr. Carlotta Chernoff testified that they made independent assessments throughout the appraisal process,[2] and arrived at comparable interpretive results that were both plausible and in agreement with available data.

30. The Exploration team's volume and economic assessments were based upon their interpretive view of risks and uncertainties, which were appropriate given their responsibilities in the appraisal process, and were all within the range of interpretive possibilities. These assessments were also strongly influenced by analogous discoveries in the deepwater Gulf of Mexico that appeared to be of lower viability. Regardless, as the appraisal continued, Exploration appropriately adjusted their volume and economic assessments. And it was Anadarko's Development team, which Merrill opined had a "more credible" faulted subsurface interpretation,[3] that directed the appraisal activities after Shen-4.

31. Anadarko's Development team provided a range of development solutions that were adjusted to match the changing appraisal results. The evidence demonstrates that the

[2] Chernoff Dep. Tr. 37:5-38:6, 200:12-201:12.

[3] Merrill Rpt. ¶ 61.

Development team conducted significant technical work in designing practical, fit for purpose development plans throughout the project.

32. While Plaintiffs' experts are critical of interpretive elements of Anadarko's resource size estimates and commercial evaluations, they do not provide any alternative evaluations or calculations based upon their own analysis of the data, nor do they grapple with the partners' evaluations all supporting continued appraisal—notwithstanding differences in subsurface interpretations—or the fact that Shenandoah is currently being developed. Qualitative issues that Plaintiffs' experts use to disparage Anadarko's Development team's technical work are typically already considered and accounted for in their evaluations and calculations.

33. Plaintiffs' experts' assertions about the commerciality of Shenandoah, specifically that it was not commercial after either Shen-3 or Shen-4, are not supported by my review of the evidence or by the contemporaneous assessments of the technical staff and management at Anadarko and its partners (ConocoPhillips, Cobalt, Marathon, and Venari) who all supported continued investment in appraisal of the Shenandoah prospect based upon their independent assessments of potential future commerciality. Even after Anadarko announced the suspension of the appraisal of Shenandoah following the disappointing results of Shen-6, ConocoPhillips, Cobalt, and Venari continued to argue for a commercial development plan. Indeed, today, a new partnership in which Beacon Offshore Energy Development LLC is operator has made a final investment decision ("FID"),[4] filed a development plan with the Bureau of Ocean Energy

[4] Navitas Petroleum Limited Partnership, Final Investment Decision ("FID") for the Shenandoah Project Development (August 26, 2021).

Management ("BOEM"),[5] and is actively developing the Shenandoah field.[6] This demonstrates that Shenandoah has commercial value.

34. Finally, I understand that a key issue of this matter is whether statements from Anadarko's public statements regarding its results throughout the appraisal process were false or misleading. Based on my review of the public statements in the Amended Complaint, in conjunction with the documents produced in this case, I believe Anadarko's statements about Shenandoah were accurate. The alleged omissions that Plaintiffs identify are either commonly known uncertainties, such as the risk of faulting, or detailed technical disagreements that I would not expect to be disclosed. Plaintiffs experts repeatedly refer to Anadarko's "public statements" in their report, but have not shown that any statements were inaccurate or misleading. They both largely disclaimed any assessment of Anadarko's public statements. Indeed, when asked about a statement in his report referencing Anadarko's public statements during his deposition, Pittinger testified, "In the context of this case public statements weren't the focus of my work. I reference it here, but it does not -- it is not a main part of my report. I'm not aware of other places in the report that have -- may opine on what was said to the public. In general, that was outside the scope of my report."[7] Merrill testified only about two public statements, clarifying that when he wrote in his report about Anadarko's "overly optimistic statements," he referred only to a single statement Anadarko made about the opportunity of the Shenandoah mini-basin.[8]

[5] Beacon Offshore Energy, Supplemental Development Operations Coordination Document (March 14, 2022).

[6] Navitas Petroleum Annual Report 2021, at p. 50.

[7] Pittinger Dep. Tr. 95:10-96:1.

[8] Merrill Dep. Tr. 151:6-16.

B. Summary of Rebuttal to Merrill's Opinions

35. **Merrill ¶ 18(a):** "Shen's resource size shrank substantially with each well post-Shen-2 and fell below the range of expectations for the prospect post-Shen-2."

36. **Rebuttal to Merrill ¶ 18(a):** Merrill does not know what Shenandoah's producible resource size is and cannot assess whether it is outside of any range post-Shen-2. During his deposition, Merrill testified that he was in fact referring to Anadarko's probabilistic resource ranges—internal estimates that reflect a range of uncertainty.[9] It is normal for estimates to change over the course of an appraisal process. Even though its median resource estimate went down, throughout the Class Period, until receiving the results of Shen-6, Anadarko estimated that Shenandoah contained significant resources that could potentially be commercially developed. That Shenandoah is being developed today further indicates that sophisticated oil and gas companies believe there is sufficient recoverable oil to justify production.

37. **Merrill 18(b)**: "Anadarko's resource range for Shen did not adequately reflect its structural uncertainties and sand thickness variability in the Wilcox turbidite fans."

38. **Rebuttal to Merrill 18(b)**: Merrill opines that Anadarko Exploration's resource range was too narrow, "expressing more certainty" than he thought was appropriate.[10] While Merrill criticizes Exploration's range, he does not offer any estimates of his own. Merrill recognized during his deposition that he could not determine if the resource range did in fact reflect the structural uncertainties without information from developing the field.[11] He also admitted that

---

[9] *Id.* 72:14-19.

[10] *Id.* 42:4-43:2.

[11] *Id.* 38:23-39:3 (Q: "And did there ever come a time where Shenandoah did begin to have a resource range that adequately reflected its structural uncertainties?" A: "I can – because the development – because there was no development here, I can't answer that. I have no – no understanding of that.").

there was an "uncertainty" as to "how many faults were there; were those faults sealing, laterally sealing."[12]

39. More fundamentally, these resource estimates were entirely internal to Anadarko and were used to identify key remaining uncertainties to determine where to drill the next appraisal well. While Exploration and Development disagreed as to the appropriate resource estimates, the disagreements between those teams were based on different technical approaches and the differences in assessments of risks between those teams more broadly. Merrill's assertion that either Exploration's or Development's estimates were overly optimistic i based on the benefit of hindsight, since exposing potential downsides is the objective of appraisal.

40. **Merrill ¶ 18(c):** "Compartmentalization and faulting posed a serious risk to Shen's producible resource size and commercial viability."

41. **Rebuttal to Merrill ¶ 18(c):** Although faulting does pose challenges to any planned development, faulting in deepwater basins, and in analogous Gulf of Mexico lower tertiary subsalt basins, is fairly common and has not been a serious hurdle to development (such as Mad Dog, Atlantis, Stones, Jack, Cascade, and Chinook).[13] Faults do not necessarily have an adverse impact on the recoverable resources in a field. Rather, they inform the development plan that determines the best way to access them. Faults may or may not be sealing and may or may not divide the field into compartments.[14] Compartments that are large enough to support the cost of one or more wells do not lower the recoverable resources or adversely impact the economics.[15]

---

[12] *Id.* 46:2–9.

[13] *See, e.g.*, Morris Dep. Tr. 135:23-136:1 ("And so it's not uncommon for reservoirs to be broken up into individual pieces where you'll need multiple wells to drain those individual pieces here.").

[14] Chernoff Dep. Tr. 47:21-51:6.

[15] *Id.* 51:7-51:10.

Faults that are sealing today at equilibrium often begin to leak hydrocarbons across them when pressure differences due to production exceed their sealing capacity, and these volumes are often recovered. Development Manager Pat McGrievy supported this view when he testified that even sealing faults "can break down through pressure depletion and you can start communicating across those faults," after which "you can start producing it."[16]

42. Adverse impact resulting from unmapped faulting is accounted for in the reservoir engineer's assessment of "recovery factor." Anadarko reduced its recovery factor from an initial un-faulted field assessment of 25-35% to a final faulted field assessment of 15-18%. Finally, there are well technologies (lateral wells, SMART completions, etc.) that are available specifically to address these issues. In my expert opinion, analogous Gulf of Mexico subsalt lower tertiary developments have demonstrated that compartmentalization or faulting at Shenandoah could likely be accounted for in the field's development planning and were by no means insurmountable hurdles for Shenandoah's future commercial viability.

43. Merrill opines that compartmentalization "was a risk for the entire program,"[17] but when asked what this meant, Merrill explained that in his opinion, Anadarko would have to drill additional wells to reduce uncertainty, and "if you have to drill too many wells and you're not going to produce enough hydrocarbons . . . it's not a commercial enterprise."[18] This logic is circular. Whether Anadarko would have had to drill "too many wells" or whether the field was "not going to produce enough hydrocarbons," were precisely the uncertainties to which the appraisal program was addressed, and as Merrill himself recognizes, the way to reduce these

[16] McGrievy Dep. Tr. 116:13-117:1.

[17] Merrill Dep. Tr. 57:24-25.

[18] *Id.* 60:10-25.

uncertainties is to drill additional appraisal wells.[19] He testified that there is "always a range of possible outcomes," and there is "uncertainty in the placement of faults" when looking at the seismic data, noting that it is "when we drill the wells, now we get some certainty."[20] Merrill admitted "[u]ncertainty still remained" at Shenandoah, noting that there was uncertainty as to how many faults were between Shen-2 and Shen-3, and Shen-2 and Shen-4.[21] Indeed, Merrill opined that this uncertainty remained throughout, testifying that commerciality "was unknown at any time during the class period."[22] He opined that, based on the geological and technical data, "it's unclear how many wells were going to be needed to . . . produce any hydrocarbons," and "we didn't know how these . . . how many wells were ultimately going to be drilled, what kind of production systems were going to be required. All these uncertainties."[23]

44. **Merrill ¶ 18(d):** "Pressure data could not be used to reliably project OWCs across the Shen field following the results of Shen-3."

45. **Rebuttal to Merrill ¶ 18(d):** Merrill is incorrect; pressure data from Shen-3 could be used to project oil-water contacts ("OWCs") because it was thought that Shen-2 and Shen-3 were in pressure communication through a common aquifer. Merrill bases his conclusion on the interpretation that there is "a fault between Shen 2 and Shen 3"[24] and that "[i]f there is a fault, one would not expect a common aqu[i]fer."[25] This is not true for several reasons including the thickening wet sands and expected improving vertical connectivity of the sands downdip, the

[19] *Id.* 48:10-17.

[20] *Id.* 46:11–47:5.

[21] *Id.* 47:10-18.

[22] *Id.* 63:20-21.

[23] *Id.* 74:12-75:4.

[24] Merrill Dep. Tr. 181:21.

[25] *Id.* 183:9-10.

disappearing throw mapped on the fault before reaching the basin center, and the highly likely juxtaposition of downdip wet sands on either side of any potential fault. I am not aware of any documents or testimony indicating that individuals on the Anadarko appraisal team knew that a potential fault between Shen-2 and Shen-3 was sealing through the aquifer. Anadarko Development and Exploration, and the partners, all used pressure data from Shen-3 to project OWCs.

46. **Merrill ¶ 18(e):** "Tar posed a serious risk to the commercial viability of Shen."

47. **Rebuttal to Merrill ¶ 18(e):** Merrill admitted during his deposition that he did not have the technical knowledge or experience to opine whether a well that encountered tar would impede a project's development.[26] Moreover, his analysis is incomplete and inadequate. Merrill opines that "[t]ar posed a serious risk to the commercial viability of Shen" but has not demonstrated that by any examples or analogues. Tar formation in deepwater Gulf of Mexico ("GOM") reservoirs is not unusual and has not deterred major developments.[27] Tar typically forms near fault zones—and paleo—OWCs. Tar is water-washed by the aquifer and can arise from density separation of oil that has settled or whose lighter hydrocarbon components have migrated. Tar would only be an issue if it is extensive enough to impede either oil flow or water pressure support from the downdip aquifer. However, observations from other similar encounters in the GOM have shown that the tar is typically not laterally extensive,[28], meaning that fluid flow and aquifer support

[26] *Id.* 194:6-16 ("Q Does the presence of tar limit the ability altogether to develop a prospect? A That's a question for an engineer. Q Are there steps to mitigate the presence of tar or is that a question for an engineer? A Again, I'd have to refer to my reservoir engineer. Q Are you familiar with any projects in the Gulf of Mexico that have been terminated because of tar? A Not to my knowledge.").

[27] IADC/SPE 111600, 2008, G. Han, et. al. ("Many operators such as ConocoPhilips (Spa Prospect), Chevron (Big Foot), BP (Mad Dog) have reported bitumen encounters.").

[28] SPE/IADC 105619, 2007, M.H. Weatherl ("[E]xperience shows that tar in deep water Gulf of Mexico tends to be limited in size, often penetrated in one well but not another a few hundred feet away.").

is minimally impacted despite some wells encountering it. Moreover, the fact that the encountering of tar was known and acknowledged by all partners, and was not viewed as a major concern, confirms that these encounters were not as "serious" as Merrill opines.

48. **Merrill ¶ 18(f)**: "Anadarko designated unsuccessful Shen wells as successful ones."

49. **Rebuttal to Merrill ¶ 18(f):** Merrill does not opine on which wells he views as unsuccessful. During his deposition, Merrill defined "successful" as having "found hydrocarbons" because in his experience, "[w]hy would I drill a 200 million-dollar well if I don't expect to find hydrocarbons?"[29] He does, however, recognize that "stratigraphic wells are drilled for other reasons" and are drilled "with no intention of finding hydrocarbons."[30]

50. The evidence is clear that Shen-3 and Shen-4 were successful appraisal wells. A well can also be a successful appraisal well if it: 1) provides more information about the field; and/or 2) satisfies most pre-drill objectives. As detailed in my report, there is strong documentary evidence and deposition testimony that Shen-3 provided the partnership with helpful additional information and met many of their pre-drill objectives.[31] Among other things, it enabled the projection of oil-water contacts and confirmed lateral sand continuity. And while Merrill does not clearly opine that Shen-4 was one of these "unsuccessful" wells, Shen-4, first Shen-4 sidetrack, and Shen-4 sidetrack bypass were also successful wells in that they 1) defined the up-dip limit of the basin, 2) found ~640' of net oil sands in reservoirs correlatable to other wells in the basin,

[29] Merrill Dep. Tr. 71:13-18.

[30] *Id.* 71:21-23; 72:6-7.

[31] McGrievy Dep. Tr. 278:24-279:1.

3) defined the level of complexity and faulting near the western up-dip edge of the basin that was important for development modeling, and 4) provided the first valuable oil-saturated core data.

51. **Merrill ¶ 18(g)**: "Anadarko's Shen resource estimates, field structure and mapping, and reservoir characteristics were overly optimistic based on the internal data."

52. **Rebuttal to Merrill ¶ 18(g):** In his deposition, Merrill clarified that in this section of his report, he was referring to Anadarko's internal statements.[32] While Merrill complains that Anadarko's technical work was overly optimistic, he does not do any technical work of his own. For instance, while Merrill calls Anadarko's ranges overly optimistic, he fails to quantify how much lower he thought the P90 should have been.[33] While Merrill claims that the post-Shen-4 estimates are "more realistic," he admitted he had not analyzed the MMRAs and was not offering an opinion as to whether they were accurate.[34] Regardless, Merrill does not tie this opinion to any of Anadarko's public statements.

53. **Merrill ¶ 21:** "Leading up to the Class Period, Anadarko created the public perception that Shen was one of the largest commercial oil-field discoveries in deepwater GOM. Following the drilling of the first appraisal well, Shen-2, in March 2013, Anadarko indicated the Shen basin was a $2-$4 billion opportunity. This announcement set the public's perception, including myself, that this was a new 'giant' field."

54. **Rebuttal to Merrill ¶ 21:** Merrill correctly notes that "[f]ollowing the drilling of the first appraisal well, Shen-2, in March 2013, Anadarko indicated the Shen basin was a $2 - $4 billion opportunity" but confuses the "opportunity" presented for Shenandoah basin with

---

[32] Merrill Dep. Tr. 130:17-25.

[33] *Id.* 54:19-22.

[34] *Id.* 55:12-56:10.

the discovery at Shenandoah prospect. While Merrill testified that it "wasn't clear" whether the "~$2 - $4 billion opportunity" statement referred to Shenandoah or the Shenandoah basin, both the relevant presentation slide and Merrill's report clearly indicate that the statement referred to the basin.[35] At the time of this announcement, the opportunities at Shenandoah, Yucatan, and Coronado all contributed to the size of the financial opportunity in the basin, which is consistent with internally tracked values. A $2-$4 billion dollar oil & gas opportunity in the Gulf of Mexico when the price of oil was $80 per barrel might deliver upwards of $40 per barrel profit and would only require production and sales of ~50 MMBO (million barrels of oil). Anadarko's announcement of its best estimate of the data at the time never defined the Shenandoah field as "commercial" or as a confirmed "giant field."

55. **Merrill ¶ 22:** "Throughout the Class Period, Anadarko continued to reinforce the public perception that Shen was a 'giant' oil field, describing each new well as successful, even if no hydrocarbons were found, and telling the market that Shen was right within the range of expectations, even as its 'resource' size shrank with each well and commerciality was in doubt due to compartmentalization from faulting, tar, and other factors. The evidence demonstrates that throughout the Class Period, Anadarko personnel warned management about the complexity of the Shen geological structure and how that impacted resource estimates as the appraisal drilling progressed. By the end of the Class Period, the resource potential was known to be a fraction of what the public had been led to believe."

56. **Rebuttal to Merrill ¶ 22:** Merrill's review of the "public perception" is not supported by any references to any actual public statements. My review of the public statements

[35] March 4, 2014 Investor Relations Conference Presentation, APC-00003046 at slide 83 (emphasis added); Expert Report of Robert Merrill, ¶ 21.

in the Amended Complaint indicates that Anadarko's announcements throughout the Class Period gave a status of the appraisal program and factually relayed the results of each well. As explained above, there are many definitions of a "successful appraisal well." While Merrill claims that Anadarko told "the market that Shen was right within the range of expectations," it is not clear to what "expectations" he is referring. Anadarko never publicly expressed any volumetric or economic numbers for the field. The purpose of continued appraisal was to evaluate the volume and economics of the field. During appraisal, projected sizes can shrink, grow, or stay the same.

57. **Merrill ¶ 68:** "[The] exploration team ignored the risk of faulting and fault compartmentalization."

58. **Rebuttal to Merrill ¶ 68:** Merrill's characterization of Anadarko's Exploration team ignores the large and persistent variability of maps being generated both internally and by other teams in the partnership. As detailed in the following sections, each interpreter created unique structural maps with faults located in different places and with faults that would appear and disappear from their interpretation. This variability in fault mapping demonstrates the high degree of technical uncertainty associated with placing faults definitively on maps. Anadarko Exploration did not ignore the risk of faulting; it was aware of potential faulting but did not place faults on maps unless there was clear evidence of the fault and a consensus across the partnership as to its likely location.[36] For instance, Reservoir Engineering Manager Robert Strickling testified about why there was a lack of significant faulting on Exploration's maps at this point, saying, "It's not that we don't think there's any faults there, it's just that we just didn't know where they were."[37] Development generated an early faulted map and added and subtracted faults at every step of the

[36] *See, e.g.*, Marathon_004981 at slide 41.

[37] Strickling Dep. Tr. 138:21-139:1.

appraisal program. The evidence is clear that Anadarko Exploration did not "ignore" faulting nor the potential consequences of it.

C. Summary of Rebuttal to Pittinger's Opinions

59. **Pittinger ¶ 11(a) & n.1:** "Shen's producible resource size shrank with each well, falling below the operative resource range post-Shen-2." "'Operative' refers to numbers Anadarko used regarding Shen's resource range and size. Leading up to and during the Class Period, Anadarko used Exploration's numbers from May 2009 until at least Spring 2016."

60. **Rebuttal to Pittinger ¶ 11(a) & n.1:** Pittinger does not know what Shenandoah's producible resource size is and cannot assess whether it is outside of the range post-Shen-2. While he stated during his deposition that he was referring to Anadarko's internal "resource assessment,"[38] it is typical for internal probabilistic resource ranges to change over the course of the appraisal process. It is also typical for Development to project a smaller resource range than Exploration. As Pittinger clarified, Development's estimates were the "operative" resource ranges after January 2016—around the time when they took over the project.[39]

61. **Pittinger ¶ 11(b):** "Anadarko's operative resource range for Shen did not reflect its structural uncertainties, specifically fault compartmentalization, and variability in reservoir thickness."

62. **Rebuttal to Pittinger ¶ 11(b):** Resources ranges for Shenandoah field, calculated independently by Anadarko and the partners, reflected the structural uncertainties that were identified in the field. Seismic data, geologic analogues, and appraisal well data were used by each partner to generate structural and isopach maps, which were considered by Anadarko in deriving

[38] Pittinger Dep. Tr. 16:21-17:9.

[39] *Id.* 17:16-18:13.

its best estimates for resources ranges. While Pittinger complains about Anadarko's estimates, he does not support his claims with technical analysis.

63. **Pittinger ¶ 11(c):** "After Shen-2, each subsequent well reduced Anadarko's operative resource range for the Shen field, ultimately rendering the field commercially unviable."

64. **Rebuttal to Pittinger ¶ 11(c):** Pittinger's analysis relies on theoretical decisional analysis rather than the practical considerations in an appraisal process. In assessing commerciality, Pittinger looked to the Rose & Associates methodology, which he said produced post-well economics that "help the investor know if further investment [is] warranted in this."[40] Pittinger opined that, at the appraisal stage, "commercially viable" means that, "based on the uncertainties in the resource assessment, reservoir quality, the cost of the developing the field, the potential risks that have been identified to date, that the Rose and Associates methodology of calculating an expected value based on a range of potential outcomes shows that the expected return is positive."[41] However, the calculation of expected value, alone, is incomplete. Costs are an important piece of determining a project's commerciality.

65. Pittinger's "theory of decision analysis"[42] ignores the realities of the appraisal process. Pittinger admitted that "with less uncertainty one can make an investment decision with more confidence,"[43] "[e]conomic evaluations can change with time," "[c]onditions can change where [a project that was uneconomic] might be economic at a later time,"[44] and that appraisal

[40] *Id.* 27:2-25.

[41] *Id.* 41:20-42:10.

[42] *Id.* 185:12-18.

[43] *Id.* Tr. 92:1-11.

[44] *Id.* 36:17-19.

wells are drilled to reduce uncertainty.[45] Nonetheless, Pittinger opines that the "validity" of a decision, such as whether to continual appraisal, "is based on information available at the time that decision is made."[46] But during an actual appraisal program, companies learn about the reservoir and consider different development solutions. Continuing appraisal can depend on many factors, including the cost of appraisal activity, the extent of remaining uncertainties and how big the potential upside may be. Importantly, Pittinger said it was beyond the scope of his report to opine on whether companies ever do additional appraisal if the expected value of a prospect is uneconomic[47] or not commercially viable,[48] or whether companies should not drill appraisal wells on commercially unviable fields.[49]

66. Additionally, based on the evidence I have reviewed, it is untrue that Shenandoah was not commercially viable. I have not seen any evidence that the appraisal team or management at Anadarko concluded the prospect was not commercially viable. In fact, after Anadarko suspended appraisal activities, the partners indicated a desire to continue appraisal and develop the field. In addition, as of the end of 2022, the Shenandoah field is being developed by Navitas Petroleum and Beacon Offshore Energy, which have filed a $1.8 billion development plan with the BOEM[50] and are planning to produce by 2024. Clearly Pittinger's assessment that the Shenandoah field is "commercially unviable" is not shared by the experts employed by Anadarko, nor the partners, nor those currently developing the field.

---

[45] *Id.* 48:17-49:4.

[46] *Id.* 185:12-18.

[47] *Id.* 43:11-20.

[48] P *Id.* 49:5-14.

[49] *Id.* 49:23-50:4.

[50] Beacon Development Plan-BOEM 2-2021 and NS Energy Newsletter "Shenandoah Field Development."

67. **Pittinger ¶ 11(d):** "Anadarko personnel working on Shen and Anadarko's main partner on the Shen project estimated Shen's producible resource size as significantly smaller and less valuable than Anadarko's operative resource range and the range of expectations post-Shen-2."

68. **Rebuttal to Pittinger ¶ 11(d):** Each of the partner teams independently calculated resource range estimates throughout the appraisal process and updated them as additional data became available. These estimates incorporate a large amount of uncertainty, and are based largely upon individuals' subjective assessments, some of which will be higher, and some lower. The purpose of the appraisal process is to better understand the project; as a results of this process, resource estimates are expected to change. Whether resource estimates increase or decrease during appraisal is dictated by quality and extent of the resource.

69. **Pittinger ¶¶ 11(e), 56:** "After Shen-1 and Shen-2, fault compartmentalization was the major risk impacting Shen's commercial viability." "Exploration conscientiously ignored evidence of faulting."

70. **Rebuttal to Pittinger ¶ 11(e), 56**: For the reasons explained above with respect to Merrill's opinion on "ignoring" faulting, this is not supported by the record. Moreover, Pittinger overemphasizes the risks of fault compartmentalization. Fault compartmentalization was an uncertainty that Anadarko and the partners sought to better understand through drilling appraisal wells. However, the main risk after Shen-2 was the extent and thickness of oil in the large areas mapped laterally east and west of Shen-2. If "fault compartmentalization" had been the *main* risk, subsequent appraisal drilling would have been designed to test that by drilling near Shen-2, as was later done at Shen-5 and Shen-6. Additionally, as Pittinger testified, faulting "doesn't preclude a field from developing" and "[y]ou have to understand the degree of faulting in order to assess

whether it can be developed commercially."[51] Moreover, Pittinger did not conduct a thorough analysis of the risks of fault compartmentalization, as he stated that "[m]itigation of fault compartmentalization is beyond the scope of [his] report."[52]

71. **Pittinger ¶ 11(f):** "Results from Shen-3 and Shen-4 caused Anadarko's operative resource volume to decline by 64%, despite both wells being described by Anadarko as successful. After Shen-3, the estimated areal extent of the oil accumulation decreased by 47%, and following Shen-4, the volume was reduced by one-third."

72. **Rebuttal to Pittinger ¶ 11(f):** Like Merrill, Pittinger confuses "successful appraisal" with "finding hydrocarbons." A successful appraisal well does two things: 1) provides more information about the field and 2) satisfies the majority of the pre-drill objectives. Under that definition, Shen-3 and Shen-4 were successful. The purpose of successful appraisal is to make "unknowns" into "knowns" so that appropriate forward-looking decisions can be made. The fact that no hydrocarbons were found does not mean the appraisal well was not a success. Mr. Strickling confirmed that "success" of appraisal drilling was defined by safely meeting the well's objectives and allowing for logging and an evaluation program of the reservoir, and not by whether hydrocarbons were found.[53] Pittinger's own testimony confirms that "success" depends on context: When discussing internal documents describing seeking "success" at Shen-5, Pittinger said that he "need[ed] more context" to determine what it meant for a well to be successful.[54]

73. **Pittinger ¶ 11(g):** "The asphaltene deposition properties of the Shen crude oils had multiple negative impacts on commercial viability, including:

---

[51] Pittinger Dep. Tr. 121:6-12.

[52] *Id.* 119:17-19.

[53] Strickling Dep. Tr. 212:13-18.

[54] Pittinger Dep. Tr. 173:4-7.

> (i) Barriers to flow from fault compartmentalization would greatly complicate efficient pressure maintenance from either water injection wells or an aquifer required to prevent damaging the reservoir;
>
> (ii) Asphaltene onset pressures ("AOPs") rose when crude samples were blended, making commingling infeasible. Commingling, however, was necessary to keep the well count low enough to be feasible; and
>
> (iii) Under the conditions at the time, asphaltene deposition would have occurred in all Shen wells from day one to abandonment, with each well producing enough asphaltene deposits to fill miles of production tubing per year at initial rates."

74. **Rebuttal to Pittinger ¶ 11(g):** While it is true in theory that fault compartmentalization could create barriers to flow that could "complicate efficient pressure maintenance",[55] this is by no means a foregone conclusion. Structurally, Shenandoah was interpreted as uniformly-dipping towards the south, meaning that the area most likely to contain hydrocarbons would be at the shallower-depth northern area of the field, and water, which is heavier, would be more likely found at the lower-depth central area. Under these circumstances, only faults that run east-west would have the potential to cause the effect Pittinger describes here, by effectively bisecting the field and compartmentalizing oil accumulations from their downdip common aquifer." Mapped faulting at Shenandoah was principally north-south, which would be less likely to have this complicating effect. Moreover, the downdip thickening sands suggested good downdip connectivity, and common water pressure gradients across the basin supported the likelihood of aquifer pressure maintenance.

75. Pittinger also incorrectly assesses the seriousness of asphaltenes. Although asphaltenes are present at Shenandoah, this is not rare in the production of deepwater Gulf of

[55] Expert Report of Lyndon Pittinger, ¶ 11(g).

Mexico fields. In fact, asphaltenes are a relatively common issue that has been dealt with in deepwater Gulf of Mexico developments for over 20 years (*e.g.*, Typhoon,[56] K2,[57] and Blind Faith[58]). For example, the authors of a 2017 paper stated that "[d]eepwater fields, such as those encountered in the Gulf of Mexico (GoM), often exhibit reservoir tar deposits and asphaltene instability."[59] To avoid problems associated with asphaltene precipitation or deposits, mitigation plans are always put in place.[60] These can be as simple as designing a development plan and production system that keeps the oil above its asphaltene onset pressure ("AOP") (by limiting drawdown or ensuring pressure support is maintained via the aquifer or through water injection), and/or by installing downhole chemical injection systems. In fact, multiple mitigation/remediation techniques to deal with asphaltene at Shenandoah were discussed, and these might include preemptive xylene soaks, coiled tubing cleanouts, acid soaks, and production logging.[61] Asphaltene dropout was a production assurance issue that Anadarko was familiar with and was not perceived as an unmanageable issue.

76. Pittinger lacks experience with asphaltenes and fails to assess their practical impact. Pittinger testified that the question of whether the "presence of high asphaltene pressures necessarily make a project noncommercial" was "outside the scope of [his] report."[62] He admitted

---

[56] Ring, et. al., "Management of Typhoon: A Subsea, Deepwater Development" SPE 84147 (2003).

[57] Lim et al, "Design and Initial Results of EOR and Flow Assurance Lab Tests for K2", Offshore Technology Conference OTC 19624 (2008).

[58] Montesi, et. al., "Asphaltene Management in GOM DW Subsea Development", Offshore Technology Conference OTC 21587 (2011).

[59] H. Dumont, et. al., "Asphaltene Onset Pressure Uncertainty", Offshore Technology Conference OTC 27826-MS (2017) p. 1.

[60] *See, e.g.*, APC-00044530.

[61] APC-00015676 at p. 45.

[62] Pittinger Dep. Tr. 96:16-97:7.

he was not familiar with "any projects where the presence of asphaltene render[ed] the project uncommercial," "did not focus on asphaltene deposition problems outside of this field," and had never worked on a project where asphaltenes were present.[63] He also acknowledged that he did not know what projects Anadarko had worked on where asphaltenes were present or how Anadarko mitigated those projects.[64] Pittinger lacks the requisite technical understanding to offer any opinion on this topic, and consequently, his opinions are both overstated and incomplete.

77. **Pittinger ¶ 11(h):** "After Shen-3, Shen's economics were marginal, falling below the corporate discounted profit to investment ratio threshold ('PIR10') and by April 2015, the PIR threshold rendered it more likely than not that Shen was commercially unviable."

78. **Rebuttal to Pittinger ¶ 11(h):** Pittinger argues that Anadarko and each of its partners knowingly wasted resources on a likely "commercially unviable" appraisal of Shenandoah field. This is not supported by the record or common sense. Oil and gas exploration companies like Anadarko appraise prospects like Shenandoah to understand the prospect and ultimately determine if they can be economically produced. When a company makes a discovery in a region like deepwater Gulf of Mexico, it is highly unlikely that the company can determine commerciality before completing the appraisal; that is the very purpose of appraisal. Pittinger ignores this reality.

79. PIR values are singular references that can and do change over time. The PIR values that Pittinger quotes are for "mean" or "P50" cases. The range of potential outcomes of a project before its appraisal is completed may span PIRs from negative values (losing money) to wildly profitable. PIR calculations heavily depend on assumptions related to available technology, estimated costs, and development options, and early calculations of PIR are used to identify areas

[63] *Id.* 97:8-98:16.

[64] *Id.* 102:12-24.

where resources need to be focused. These numbers change as the uncertainty is narrowed and the development plan is formed.

80. Pittinger also relies on speculative testimony about Anadarko's "hurdle rate" to suggest that Shenandoah was more likely than not commercially unviable because it was below the "investment ratio threshold." He cites to the testimony of Darrell Hollek, formerly Anadarko's Executive Vice President of U.S. Onshore Exploration and Production, who testified that a PIR10 of 0.3 was "a general guideline."[65] But Hollek did not testify that if a project's PIR10 is modeled below 0.3 at any point in time, the project becomes commercially unviable and will not receive funding. As Chris Camden, a reservoir engineer for Anadarko's Exploration team during the Shenandoah appraisal, makes clear in his declaration, Anadarko's "informal PIR 'hurdle rate' of 0.3" was generally understood to mean that projects should deliver 30%, or greater, more profit than the sum of investments over the life of the project," but there "was no policy requiring that a project receive a PIR of a 0.3 to continue appraisal or to be sanctioned, and a 0.3 hurdle rate was not a strict guideline for investment."[66] Rather, "[d]uring the appraisal process, the appraisal team would not consider a PIR rate less than 0.3 to signify that the appraisal should cease or the project should not proceed further, particularly if there remained uncertainties about the resource and cost of development."[67]

81. This aligns with my understanding of the PIR and experience with PIR calculations over the course of my career. As to whether to continue appraising, the PIR may be relevant but other factors that must be considered in deciding whether to continue the appraisal include non-

---

[65] Hollek Dep. Tr. 53:16-54:4.

[66] Chris Camden Declaration ¶ 7.

[67] *Id.* ¶ 8.

technical risks, downside risk, and exposure to the upside. While the PIR would be an important criterion to judge potential development, in my experience, it is not used as the basis to terminate appraisal activities. At the time of a final investment decision ("FID"), *i.e.*, when the company determines whether it will sanction the field, companies often look to the PIR as well as many other factors. In addition, investments must be balanced across a corporate portfolio to keep the company robust in view of future uncertainties in opportunities and commodity prices.

82. **Pittinger ¶ 11(i):** "Shen 3 could not be used as an injection well or other type of service well and had no future utility."

83. **Rebuttal to Pittinger ¶ 11(i):** Although it was ultimately determined that Shen-3 would not be used as an injector well, its possible use as an injector was not initially settled and was partially dependent upon technology available at the time. There was some question of whether Shen-3 could not be used a water injector because of the design and condition the well was left in,[68] and that the required "technology did not exist" at that time "to complete the Shenandoah 3 well based on the tree which is at the top of the wellbore."[69] However, Bob Daniels, Anadarko's former VP of International and Deepwater Exploration, testified that he believed that, when and if engineering became available, Shen-3 could potentially be used as a water injection well for a well to the east, even if there was a north-south sealing fault.[70] Ernie Leyendecker, who served as Senior Vice President of International Exploration and then Vice President of International and Deepwater Exploration during the Class Period, similarly testified that even if there was a sealing fault, Shen-3 could be used for pressure maintenance on the east side of the

[68] Chandler Dep. Tr. 149:17-21.

[69] Frye Dep. Tr. 79:11-14.

[70] Daniels Dep. Tr. 86:21-87:9.

field.[71] He further testified that had he had discussions about Shen-3 being used as a water injector well,[72] and that he did not recall ever learning that Shen-3 could not be used as an injector well.[73]

84. **Pittinger ¶ 11(j):** "After Shen-4, and by December 31, 2015, Anadarko senior management understood that Shen was not commercially viable. Although some evaluations showed positive calculated values, no economic evaluations included the full downside risk presented by fault compartmentalization and asphaltene deposition. Incorporating those downside risks, it was known with reasonable certainty that the corporate PIR threshold rendered Shen commercially unviable at that time."

85. **Rebuttal to Pittinger ¶ 11(j):** Pittinger's conclusion that Shenandoah was "uncommercial" is flawed. First, Pittinger's opinion relies heavily upon the initial reaction to the Shen-4 original borehole, and fails to account for additional, positive information learned from the first Shen-4 sidetrack ("Shen-4 sidetrack" or "Shen-4 ST1"). Second, Pittinger ignores the fact that no one at Anadarko considered these results to condemn the results of Shen-4. Rather, the evidence reflects that Anadarko personnel recognized the importance of the additional appraisal wells on the results of the project.[74]

86. Pittinger did not do any economic modeling to account for the allegedly negative factors he claims were not incorporated into Anadarko's modeling.[75] In fact, downside risks due to potential fault compartmentalization were accounted for by Anadarko's development team in their estimate of recovery factors to be considered. The occurrence of asphaltenes was later

[71] Leyendecker Dep. Tr. 183:23-25.

[72] *Id.* 197:8-198:24, 199:13-200:15.

[73] *Id.* 194:13-17.

[74] *E.g.*, APC-00646864; Frye Dep. Tr. 102:14-19, 206:17-207:9; McGrievy Dep. Tr. 236:16-237:25.

[75] Pittinger Dep. Tr. 76:21-2, 77:25-78:1.

accounted for with production assurance mitigations in the development plan. The purpose of calculating PIRs for P50 cases during active appraisal is to understand the key issues and identify areas where resources are to be focused. The potential "commercial viability" of Shenandoah was still very much robust after Shen-4 ST, as evidenced by the continued investment in appraisal by Anadarko and its partners.

87. In addition, while Pittinger opines that "senior management understood" that Shenandoah was not commercially viable, he also testified that Anadarko's "thinking and intent" was outside the scope of his report.[76] In my own review, I am not aware of any evidence supporting that Anadarko management determined that Shenandoah was not commercially viable. Rather, all of the documents suggest that the results of Shen-6 were required to determine commerciality.

88. **Pittinger ¶ 11(k):** "Shen-5 confirmed extensive fault compartmentalization. Even with 1,040 ft. of oil pay, the resource volume shrank significantly after the well. Tar in the LWC proves that reservoir damage from asphaltene deposition had already occurred in the reservoir, the extent of which could not be determined at the time."[77]

89. **Rebuttal to Pittinger ¶ 11(k):** Pittinger overstates the relevance of the tar encountered in Shen-5. A significant portion of the unproved resources following Shen-5 were in the area to the east of Shen-5 and up-dip of Shen-3. Anadarko Development conducted additional appraisal to understand this side of the prospect and adjusted its projected development strategy to account for a smaller resource. It also took steps to reduce costs to improve the projected economics. Shen-6 was an important well for determining the extent of the reservoir. It was the

[76] *Id.* 178:3 –15.

[77] Expert Report of Lyndon Pittinger, ¶ 11(k).

results of Shen-6 and the Shen-6ST that indicated a smaller and more complex resource than initially understood.

90. **Pittinger ¶ 17(c), (f):** "Shen-3 was drilled and tested from May 28, 2014 through November 7, 2014 and was located 2.3 miles east and 1,400 ft. down-dip of Shen-2. All sands in the well were wet. Because no hydrocarbons were found, Shen-3 was a dry hole by industry standards." "Shen-6 was a dry hole by industry standards."

91. **Rebuttal to Pittinger ¶ 17(c), (f):** Pittinger's characterization of both Shen-3 and Shen-6 as a "dry hole" instead of as a "wet well" does not follow industry standards. The term "dry hole" is an accounting term, but is also generally defined in the oil and gas industry as a well that is "unsuccessful or noncommercial"[78]—a definition that assumes that the goal of the well is targeting producible hydrocarbons. Wells that are designed to test stratigraphic features for the purpose of gathering appraisal information, such as the Shen-3 well (which was drilled down-dip of the lowest known oil, with the goal of encountering the oil-water contacts or a free water aquifer) would more commonly be described as a "wet well" rather than a "dry hole." ConocoPhillips' Project Manager, Dr. Chernoff, provided testimony on the term "dry hole", stating that "a dry hole, in my experience, is a very specific financial note -- or accounting classification," and that she "wouldn't call them . . . synonymous."[79]

IV. Foundational Information

A. General Exploration and Appraisal Process

92. Hydrocarbon exploration of any area begins with forming an exploration team to evaluate a "sedimentary basin" to evaluate if the key elements of a working petroleum system are

[78] AAPG Wiki – *Dry hole*.

[79] Chernoff Dep. Tr. 100:14-24.

likely present. The exploration team's evaluation of the basin usually determines a series of possible "plays" that can be tested further.

93. The American Association of Petroleum Geologists defines a "sedimentary basin" as: "a depression filled with sedimentary rocks. . . . The basin fill includes the rock matter, organic matter, and water deposited in this depression. . . . The essential elements of a petroleum system are deposited in sedimentary basins. Frequently, one or more overlapping sedimentary basins are responsible for the essential elements of a petroleum system. Traps are formed by tectonic processes that act on sedimentary rocks. However, the moment petroleum is generated, biologically or thermally, a petroleum system is formed."[80]

94. The American Association of Petroleum Geologists defines a "play" as "one or more geologically related prospects, and a prospect is a potential trap that must be evaluated by drilling to determine whether it contains commercial quantities of petroleum."[81]

95. Each play is characterized by a specific combination of the elements of a potential working petroleum system (*e.g.*, a source of hydrocarbons, one or more reservoir rocks, the existence of seals, and the creation of a portfolio of traps). The elements of each play must then be tested via drilling of test wells or "wildcats." Early "wildcat" well tests will give information to the exploration team concerning what elements of a commercially producible hydrocarbon deposit are present in that play, and which elements are not, even if a commercial hydrocarbon accumulation is not found. A "wildcat" well is defined to be an "exploratory well in an area where oil or gas has not yet been found in commercial quantities."[82] Even after all elements of a play

---

[80] American Association of Petroleum Geologists Wiki ("AAPG Wiki") – *Sedimentary Basin*.

[81] AAPG Wiki – *Play and Prospect*.

[82] R.E. Sheriff, Encyclopedic Dictionary of Applied Geophysics (4th ed.) p. 395.

have been proven, some plays have more risk than others, and each play has its own economic hurdles. For example, some plays may be proven to have large hydrocarbon deposits but may require further technologic development until those deposits can be economically produced.

96. Within each play, specific "prospects" are proposed and tested. A "prospect" is defined as "a potential trap that must be evaluated by drilling to determine whether it contains commercial quantities of petroleum."[83] A play may have numerous prospects defined within it, but each of these remain a prospect until they are tested by being penetrated by a well.

97. Testing of an exploration prospect may lead to a "discovery." In order for hydrocarbons "to be considered 'discovered' and a well to be described as a 'discovery' well, a hydrocarbon accumulation must have been penetrated by the well that clearly demonstrates the existence of movable petroleum."[84] Once a discovery is made, an "appraisal program" is then pursued to collect data that better defines the size of the discovery, the expected rates at which hydrocarbons can be produced, and the ultimate recoverable volumes. Given the remaining uncertainties and the significant cost and time necessary to produce such discoveries, decisions are continually made during the appraisal program to either: 1) abandon the discovery as non-commercial, 2) continue appraising to further reduce uncertainty, or 3) move the effort to the "development" phase.

98. Once a sufficient amount of critical appraisal data is acquired, the project typically transitions to a development team, where a proposed development plan can be made that is tailored to the specific characteristics of the discovery and allows for a detailed calculation of a development schedule, project costs, and life-cycle revenue. If the proposed development plan

---

[83] AAPG Wiki – *Play and Prospect.*

[84] R. E. Sheriff, Encyclopedic Dictionary of Applied Geophysics, (4th ed.) p. 299.

meets the company's and partners' economic and non-economic requirements, the project will be approved for development. This approval is typically referred to the "final investment decision" ("FID"), and most often leads to the "sanctioning" the project for development. Once a project reaches FID, execution of the development plan will begin, and significant resources and expenditures will begin to be deployed.

99. As described in greater detail below, the instant action concerns the Shenandoah discovery, which is one of three discoveries in the Shenandoah sedimentary basin that is part the Paleocene-aged "Lower Wilcox" play. The Lower Wilcox play was identified as a potentially commercial play following drilling of the Baha well in 1996. As described further below, other prospects in the Lower Wilcox play at that time that proved developable included the Great White (2002), Cascade (2002), Chinook (2003), Jack (2004), St. Malo (2003), and Stones (2005) discoveries.[85] Although Great White was in the Western Gulf of Mexico, it was the first field to demonstrate producible hydrocarbons in the Paleogene Lower Tertiary play. Producible reservoirs in the Central Gulf of Mexico Paleogene Lower Wilcox play (where Shenandoah is located) were demonstrated by Chevron with their well tests at their Jack prospect in 2006.

100. The Shenandoah sedimentary basin was identified through the interpretation of improved seismic survey data in 2004. The Shenandoah prospect was identified through seismic surveys as a potential source of commercially producible hydrocarbons in 2006, and Anadarko spud an exploratory well, Shen-1, in 2008. After Shen-1 found approximately 300 feet of oil pay, Anadarko commenced its appraisal of the Shenandoah prospect in approximately 2012 with the drilling of Shen-2 and continued with the appraisal program until 2017, when it discontinued the appraisal program following Shen-6. After the leases for the blocks containing the Shenandoah

[85] BOEM OCS Report 2021-005 Table 6, p. 71.

prospect changed hands several times, the project was sanctioned by Beacon Offshore Energy in August 2021.[86] The Shenandoah prospect is now in the development phase, with production of oil expected to begin in approximately 2024.[87]

B. The Appraisal Process

101. "Appraisal drilling is undertaken "after the discovery of oil or gas to establish the limits of the reservoir, the productivity of wells in it and the properties of the oil or gas."[88] "Appraisal drilling is a phase between exploration and field development. Both the exploration organization and the production geologist make contributions in the planning and drilling of the appraisal wells based upon data available, industry analogues, and their personal experiences and opinions. Appraisal is a very complicated process, and the details of the operations depend largely on the unique geological characteristics of the particular case in hand. Because of the complexity and uniqueness of the geological conditions in most oilfields and the paucity of the geological information normally available in the appraisal stage, the planning of field appraisal is to a considerable extent based on subjective judgment. Subjective judgment, in turn, is helped greatly by experience."[89]

1. Key Appraisal Elements

102. In general, appraisal programs are designed to test six key elements of a hydrocarbon accumulation:

1) "Hydrocarbon Source" – Oil and/or gas is generated within buried hydrocarbon "kitchens" where accumulated organic material (decaying animals and plants) is subjected to heating (temperature) and pressure such that a chemical

[86] Oil & Gas Journal - Beacon Offshore Advances Ultra-deepwater Shenandoah Project | Oil & Gas Journal (ogj.com).

[87] NS Energy Newsletter - Shenandoah Field Development, Gulf of Mexico, USA (nsenergybusiness.com).

[88] Oil & Gas Wiki – *Appraisal Drilling*.

[89] Developments in Petroleum Science, Vol. 20(1985) pp. 163-178.

conversion to a range of chemical carbon-hydrogen molecular chains occurs, with longer carbon chains resulting in oils, and shorter carbon chains resulting in gases. Depending upon the original source material and associated burial history, a hydrocarbon may also contain a range of impurities that have to be identified and accounted for.

2) "Migration" – The generated oils and gasses are more buoyant than the water that saturates the overlying porous rocks. Thus, once "cooked", the oil and gas migrate up through the rocks via capillary pressure and migration pathways (such as faults) until it is trapped by some non-porous sealing material.

3) "Seal" – A material through which the migrating hydrocarbons cannot penetrate. Different seals are characterized by different entry pressures that are required for hydrocarbons to penetrate. "Light" hydrocarbons (gas) can penetrate some potential seals that "heavy" hydrocarbons (oils) cannot. Seals are typically very low porosity overlying shales or carbonates, nonpermeable salt, or faults whose material along the fault plane is impermeable, or whose offset juxtaposes the trapped hydrocarbons against a sealing material.

4) "Reservoir" – A material that can contain the hydrocarbons. A "good" reservoir must be of sufficient size (vertical thickness and lateral extent) and have enough storage space in the rocks (porosity) to hold sufficient quantities of hydrocarbons to be of interest for investment. A reservoir must also have properties (*e.g.*, permeability, rock quality) that will allow hydrocarbons to move easily from locations within the reservoir into boreholes that are used to extract them.

5) "Trap" – An appropriate configuration of reservoir and seals that allow the hydrocarbons to be retained and accumulate over a geologically significant resident time. Traps are usually categorized as "structural" or "stratigraphic", or a combination of the two. Structural traps take advantage of the orientation of the reservoir and seals (*e.g.*, anticlines, fault traps, traps against salt) that contains the hydrocarbons. Stratigraphic traps (*e.g.*, pinch-outs) take advantage of a lateral depositional termination of the reservoir at some up-dip edge. "Up-dip" commonly refers to areas that are either located at a shallower relative depth on a sloping structure or are located at a position closer to the sediment origins for depositional systems. "Downdip" indicates the opposite direction. The majority of large fields around the world are categorized as being in structural traps.

6) "Timing" – In order for a hydrocarbon accumulation to occur, the generation and migration of the hydrocarbons must proceed/coincide with the timing of the creation of the trap. If hydrocarbon migration occurs too early, they will escape before that trap is created to capture them. Trapping configurations change over geologic time, and it is not uncommon for geologically historical traps to have spilled either part or all of their hydrocarbons sometime in the past.

103. Without wells that penetrate the rocks and fluids in the subsurface, these six elements can only be inferred and estimated using seismic data and other remotely acquired data (*e.g.*, gravity, electromagnetics). The exploration effort seeks to estimate the existence of each of these elements and uses these estimates to make an assessment as to the likelihood of encountering a hydrocarbon accumulation. Once an exploration well has been drilled and a discovery is made, the appraisal process is necessary for determining the economic viability of developing and producing the discovery. To do this, information on the distribution, extent, variability, connectivity, and producibility of the hydrocarbons is needed. This requires collecting data about the reservoir rocks and fluids and testing the limits of reservoir. In plays that can be well-defined and imaged with seismic data, the appraisal can be done with minimal drilling, instead relying on data collected from the discovery well and the high-quality seismic data. However, Lower Tertiary discoveries like Shenandoah that are covered by thick, complex salt are much more challenging to image using seismic data and typically require more extensive appraisal drilling programs to reduce the uncertainty in their recoverable volumes.

2. Estimating Stock Tank Oil Originally in Place – "STOOIP"

104. Determining the volume of recoverable hydrocarbons in a prospect is one of the major tasks of any appraisal program. This "recoverable oil" is calculated as the product of the "stock tank oil originally in place" ("STOOIP")[90] and the "recovery factor", or the percentage of STOOIP that will be able to be produced through the wellbore.

[90] "STOOIP" and "STOIIP", which stand for "Stock tank oil initial in place," are used interchangeably in the oil and gas industry.

105. STOOIP represents the total amount of oil in the reservoir if it were all brought to the surface at standard temperatures and atmospheric pressure. It is calculated using the following equation: **STOOIP = GRV_{oil} * NtG * Por * S_{oil} * 1/B_{oil}**, where:

1) ***GRV_{oil}*** is the "gross rock volume" of the trapped reservoir container that is oil saturated. It is guided by the thickness of the oil reservoir, its areal extent, and the location of the downdip oil-water contact. If quality seismic is available, this value can often be estimated with reasonable certainty.

2) ***NtG*** is the average percentage of net reservoir rock within the gross rock volume (*i.e.*, it is the gross rock volume minus intervening shales and non-reservoir rock), accounting for any lateral variability. It is sometimes denoted as ***N/G*** or ***N2G***. This value can be measured with well logs in each exploration and appraisal well, and its lateral variability can be assessed from analog geologic models.

3) ***Por*** is the average porosity of the net reservoir rock, accounting for any lateral variability. This value can also be measured with well logs in each exploration and appraisal well, and its lateral variability can be estimated from laboratory sampling of rock core and from analog geologic models.

4) ***S_{oil}*** is the oil saturation percentage of the oil-water system in the pore-space (*i.e.*, how much of the fluid in the pores is oil and how much of it is water). This value can be estimated with well logs in each exploration and appraisal well, and it can be measured more precisely through laboratory testing of fluid samples taken from the wells.

5) ***1/B_{oil}*** is the oil expansion factor, which describes the extent to which the oil contracts when it is brought to the surface and saturated gas comes out of solution. This value is determined from laboratory measurements of fluid samples collected from the wells.

106. The overall recovery factor likewise depends on a multitude of factors, including the oil's viscosity, the completion design, the drive mechanism (aquifer size, reservoir compressibility, etc.), the development plan (number of wells, production lifetime, etc.), and the average permeability of the porous reservoir accounting for any lateral variability. In contrast to calculations of STOOIP that follow the above equation, estimation of the recovery factor is a combination of physics, historical values from analogue fields, and even the personal experiences of the engineers making the estimates. Recovery factors are often not accurately determined until

a field has already produced a significant fraction (*e.g.*, upwards of 80% or more) of its hydrocarbons. That said, "[d]rive mechanism has the greatest geological impact on recovery factor." [91] When estimating recovery factors, engineers are instructed to "[d]ecide which drive mechanism is most likely from the geology of the prospective reservoir system and compare it with reservoir systems of nearby analog fields or analog fields in other basins."[92]

107. Because development of resources in deepwater Gulf of Mexico involves years of planning and construction that costs billions of dollars, a high degree of confidence in each of the variables listed above is necessary before a final investment decision is made, and appraisal activities are undertaken to reduce the uncertainty associated with them. These activities require the collection of additional data, interpretation of that data, and the making of estimates as to their mean value and their range of uncertainty for each variable. Subsurface data is collected from widely spaced wellbores, and geologic models, seismic, and analogues are used to interpolate both between any well control, and to extrapolate away from the well control. Each new piece of information seeks to polarize the project towards a decision of either Abandonment or Development.

108. Although exploration and production companies calculate these variables using the best available data, all prospects have some level of associated uncertainty. If that uncertainty is small enough that the range of possible outcomes meet the company's strategic and economic requirements, the project will be "sanctioned"—meaning the company will choose to make the significant investment necessary to develop the prospect. If the range of uncertainty is not narrow enough to confidently make this decision, typically either additional appraisal work is initiated to

[91] AAPG Wiki – *Predicting Hydrocarbon Recovery*.

[92] *Id.*

continue to reduce these uncertainties, or the project is abandoned as non-commercial. Reaching this "sanction" decision and progressing to first production for the ten deepwater Wilcox discoveries producing by 2019 averaged nearly 9.5 years.[93]

3. Types of Exploration and Appraisal Wells

109. Exploration wells are usually designed and drilled to determine if any hydrocarbon accumulation exists. This means that the last drilled section of the wellbore is typically left uncased and that the well design is not suitable for inserting "completion equipment" into it to be used as a future "producer." These simplifications and limitations reduce the cost of the exploration well and are preferred because typically only 20% to 35% of deepwater Lower Tertiary exploration wells encounter producible hydrocarbons.[94] If the exploration well does not encounter producible hydrocarbons or if it has no future use, it is "plugged and abandoned" ("P&A-ed") according to regulatory requirements. If the wellbore might have future utility as either a sidetrack or some other use, it can be "temporarily abandoned" ("TA-ed"), where only the open hole section is cemented, the cased wellbore is filled with fluid, and safety valves are installed. This allows decisions about the future of the wellbore to be deferred but leaves open a future obligation for either use or P&A operations.

110. Appraisal wells may be designed and drilled either as "keepers," which require a more expensive, permanent configuration, or as wells that designed to collect data, and which are intended to eventually be P&A-ed. If an appraisal well targets a low-risk area of the prospect (*i.e.*, an area expected to contain producible hydrocarbons), it will likely be designed both to collect data and as a "keeper," that is, to eventually be used as a development well before being TA-ed.

[93] BOEM OCS Report 2021-005 Table 6, p. 71.

[94] *Id.* (21 discoveries from 72 exploration wells).

It is common to TA a potential development well and defer the expensive "completion" work (creating perforations, inserting screens, running tubing, packers, etc.). Inserting the completion equipment is often scheduled after a final investment decision is made and the development project begins. Appraisal wells that target riskier locations (*e.g.*, when drilling to establish oil-water contacts, testing other fault blocks, or determining uncertain extents of the prospect) are commonly designed more like an exploration well, with optionality to sidetrack the well and/or drill by-pass boreholes. The primary purpose of these wells is to collect data and reduce uncertainties.

111. Exploration and appraisal wells are also typically designed to allow them to be "sidetracked" or "bypassed." "Sidetrack" wells involve milling a hole through steel casing already cemented in the well to start drilling a new hole. They are drilled using a portion of the pre-existing well to a certain depth, but then are drilled to target a different "bottom-hole location." "Bypass" wells are new holes that originate in the existing wellbore's "open hole", where no casing has yet been run. As compared to sidetrack wells, they initiate in a pre-existing well-bore at a greater depth and can only target a bottom-hole location that is typically much closer to the well that is being bypassed. They are usually drilled in order to gather data that cannot be gathered from the pre-existing well (*e.g.*, to collect a "core sample"), or if an existing hole can no longer be maintained.

4. Defining "Net Pay"

112. "Net Pay" is typically defined as the thickness of the producible rock, where producible rock is limited to the rock interval that "will flow oil and gas economically." These descriptions vary widely between regions and reservoirs and depend upon "cut-offs" that are nonuniformly chosen by petrophysical interpreters. There is no universally accepted definition of net pay and there is no prescriptive method for evaluating it. More "net pay" is typically good, but complexities in net pay distribution and uncertainty in its areal extent dictates that "net pay" alone

cannot determine whether a discovery will be economically producible. At Shenandoah, net pay was estimated for each reservoir penetration by Anadarko petrophysicists and shared/validated by petrophysicists at partner companies.[95] Non-pay intervals may be made up of anything that is considered "non-producible rock", including oil sands that have lower porosity or are high in water saturation

5. Oil-Water Contacts

113. Because oil is less dense than water, oil has a tendency to "migrate" upwards through reservoirs and then come to rest above water and below a trapping mechanism. In a container or reservoir, a water and oil mixture at equilibrium will separate into two fluids, with the oil settling above the water and a somewhat defined bounding surface forming between each of them. If the only force that acts upon these fluids is gravity, this contact surface is level within the container and is defined as the oil-water contact level.[96] Each reservoir container may have its own unique oil-water contact.

114. Oil-water contacts are important because they define the lower limits of the oil accumulation, thus are necessary to understand how far downdip the oil column extends and the total size of the oil accumulation. Determining the oil-water contact unambiguously can only be done by penetrating it with a well. When that data is not available, there are still a variety of methods used to estimate—or "project"—its location or to place limits on an interval that it must lie within.

[95] APC-00001085 slides #6-9.

[96] Schlumberger Energy Glossary – *Oil-Water Contact*.

6. <u>"Deterministic" Versus "Probabilistic" Calculations</u>

115. In the oil and gas industry, the key elements described above are uncertain and can only be estimated within a range of values. Many values relevant to an appraisal (such as STOOIP, defined above) are combinations of other values, each of which has an uncertainty and likely range of values associated with it. The uncertainty distribution for many of these unknowns is not uniform, and each parameter has a most likely value, a reasonable maximum value, and a reasonable minimum value. A "uniform" distribution means that every outcome is equally likely – *e.g.*, the likelihood of any number, 1 through 6, when one rolls a die. However, when one rolls two dice, the likelihood of the total, 1 through 12, is not uniform since some totals are more likely than other totals. This gives rise to a non-uniform "probability distribution."

116. The likelihood distribution of any value of a parameter defines its "probability distribution."[97] Probabilities of occurrence can span from 0 to 100% (100% = proved). For general comparison between values and between projects, most companies deal with some "reasonable range" of cumulative likely outcomes – P10 to P90, or P15 to P85. The "P90" estimate of an uncertain parameter is roughly defined as the estimate at which there is a 90% chance that the parameter has a value that is equal to or greater than the estimate Likewise, the "P50" or "P10" estimates of an uncertain parameter are roughly defined as the estimates at which there is a 50% or 10% chance, respectively, that the parameter has a value equal to or greater than the estimate. P50 and P10 are typically used as the mid-case and high-end estimates, respectively. These values can be determined by estimation from a specific example or can be determined by calculating occurrences statistically from many examples. One should note that most companies follow this

[97] *See, e.g.*, Glantz, et al., "A Primer on Risk Mathematics," in *<u>Multi-Asset Risk Modeling</u>* (Academic Press 2014).

definition of "P10" and "P90", but a few companies (*e.g.*, Marathon) refer to them in an opposite manner.

117. When calculating STOOIPs or recoverable volumes, many uncertain parameters must be multiplied together to arrive at a volumetric estimate. During an appraisal program, these estimates may be calculated using "probabilistic" (sometimes also referred to as "stochastic") methodologies. Probabilistic estimates entail sampling each input parameter's value independently according to their likelihood, and thousands of numerical models of every combination of parameter values, weighted by their likelihood, are generated in a computer to derive estimates of the P90, P50, and P10 values. The high-end and low-end estimates are usually more representative of the range of possible values, but there is no actual physical model associated with any of the estimates—only statistical estimates of the volumes.

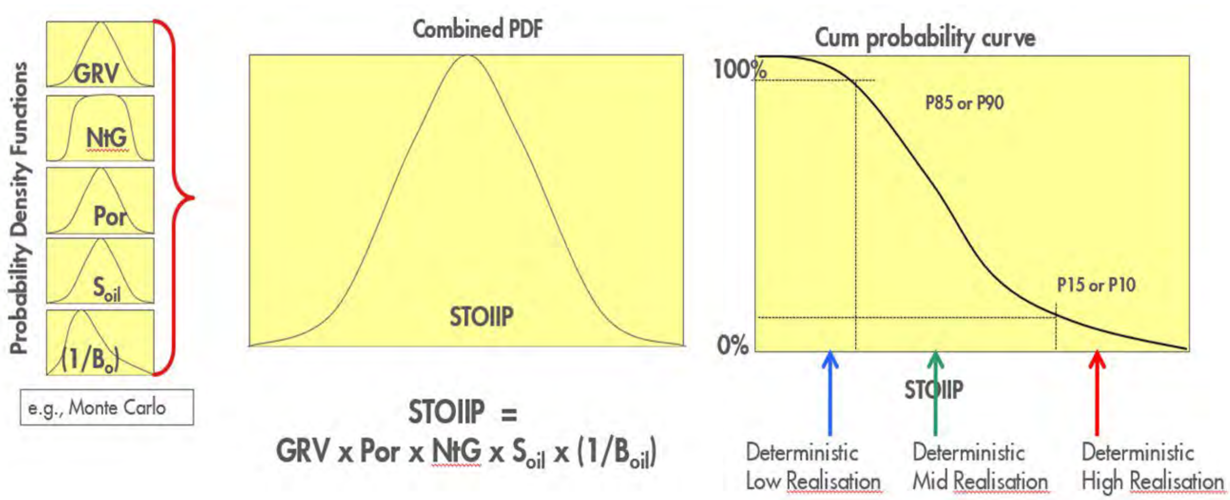


Figure 1 – Probabilistic calculations for STOIIP. Each input has a range of possible values and a likelihood for each value. When they are multiplied together thousands of times with values weighted by their likelihood, a combined "Probability Distribution Function" (PDF) results. If one integrates this PDF, one will get the "Cumulative Probability" curve on the right that defines P90 and P10. Deterministically derived values for P90 and P10 are derived from specific models and typically occur at different points along the curve.

118. Volumetric estimates can also be made "deterministically" – *i.e.*, specific, physical examples of the P90, P50, and P10 models are made with specific choices of each of their

parameter values, and the resulting volumes are calculated from each of these P90, P50, and P10 models. These estimates would be referred to as "deterministic" estimates since each estimate corresponds to a "deterministic" physical model.

119. Each method of volumetric estimation has its advantages and disadvantages, and both are commonly used.

7. Fluid Quality

120. Each fluid in a reservoir has a certain "quality" that is defined by the compounds and elements that make it up. Oil is a mixture of molecular chains of carbon and hydrogen atoms with a variety of other contaminants that may be included. The length of these carbon-hydrogen chains can vary from very short chains (one to three carbon atoms), which typically exist as gases at atmospheric conditions, to very long chains (dozens or even hundreds of carbon atoms), which exist as thick oils, asphaltenes, and waxes. The quality of the oil determines how easily it flows through the reservoir's pore system, how it must be handled through the well, pipes, and other surface equipment, and how difficult it is to refine at a refinery. These characteristics impact the development system design, the percent of the oil that can be economically recovered, and the price that is paid for each barrel.

121. Water in contact with the oil also has a quality that is defined by the compounds dissolved within it (salt, calcium carbonate, etc.). The chemistry of the water is important because some water is always produced with oil, and it must be able to be separated from the oil and disposed of in some way.

122. The quality of the fluid is determined by measuring its properties both in-situ (*i.e.*, as it exists within the reservoir) and in a laboratory where collected fluids are sent and analyzed to define the abundance of each compound that make it up. These results are summarized in detailed reports that are delivered to the operator.

8. Gas-Oil Ratio

123. One of the important quality indicators of an oil is its gas-oil ratio – "GOR." GOR is defined as "the ratio of the volume of gas ("scf" – standard cubic feet) that comes out of solution to the volume of oil – at standard conditions."[98] This factor affects the mobility of the oil through the reservoir's pores and helps drive the oil to the wellbore through its expansion. In the reservoir, oil is at temperatures and pressures that can cause the lighter gaseous hydrocarbons to dissolve into the liquid oil. When the oil is brought to the surface and brought to atmospheric temperatures and pressures, this gas is released from the oil, creating free hydrocarbon gas that must be accounted for and causing the volume of oil to shrink ("B_o" is the shrinkage factor). In the Gulf of Mexico, this gas cannot be vented into the atmosphere and must be captured and dealt with by either injection back into the reservoir or by transmittal through a pipeline back to shore for use.

9. Allochthonous and Autochthonous Salt

124. A large amount of salt was deposited in the Gulf of Mexico when saltwater repeatedly flooded and evaporated over the area. This salt is highly mobile and "squeezes" through faults and sediment layers in response to heavier sediments being deposited on top of it. This gives rise to salt layers and bodies that were deposited elsewhere (beneath Paleogene sediment layers) and that are no longer in their original depositional location. Salt that has migrated is referred to as "allochthonous" salt, while "autochthonous" salt is the salt that remains in its original depositional location.[99] In the Gulf of Mexico, autochthonous salt is the deepest underlying salt layer, sometimes referred to as the "mother salt."

[98] "Glossary of Terminology Related to Responsible Gas," Colorado School of Mines, Payne Institute of Energy Policy, Jan. 31, 2022.

[99] Schlumberger Energy Glossary – *Allochthonous, Autochthonous.*

125. Salt is impermeable to subsurface fluids, and it forms a barrier to any flow of oil or gas that is migrating from below it. This property is useful when sediments are juxtaposed either against it or are located beneath it, as any fluid in these sediments become trapped.

126. However, salt also has very high seismic velocities (~15,000 feet per second) compared to the sediments that surround it in the Gulf of Mexico (~6,000 – 12,000 feet per second). This extreme velocity difference refracts the sound waves used for seismic imaging at the salt-sediment interfaces and makes proper imaging of seismic data through the salt extremely difficult. Sound waves get refracted by the salt at such extreme angles that recovery of a seismic image beneath thick salt requires acquiring data from very wide locations (wide-azimuth seismic data), and potentially from all possible directions (full-azimuth seismic data).

10. Faults and Their Impact

127. A "fault" is defined as "a planar or gently curved fracture in the rocks of Earth's crust, where compressional or tensional forces cause relative displacement of the rocks on the opposite sides of the fracture."[100] Faults can be characterized as "sealing" or "non-sealing," although every fault has a sealing capacity that can be exceeded. A "sealing" fault is one that "represents a barrier to the flow of formation fluids because it juxtaposes impermeable rocks against permeable ones."[101] "Generally, footwall and hanging wall fault slices are interpreted as to probable permeability and then they are superimposed. Fault seal analysis may also involve predicting a probability that clay will smear out sufficiently along a fault surface to prevent the flow of fluids along the fault."[102] Identifying faults—and determining whether those faults are

[100] Encyclopedia Britannica – definition of "fault" in Geology.

[101] Encyclopedic Dictionary of Applied Geophysics - definition of "Fault Seal Analysis", p. 131.

[102] *Id.*

CONFIDENTIAL

"sealing" or "non-sealing"—is a critical part of appraisal programs because sealing faults limit the amount of oil that can be recovered through any individual wellbore. In short, if the faults are sealing, each "fault block" (*i.e.*, area bounded by the sealing faults) must be penetrated by a well in order for hydrocarbons to be recovered from it.

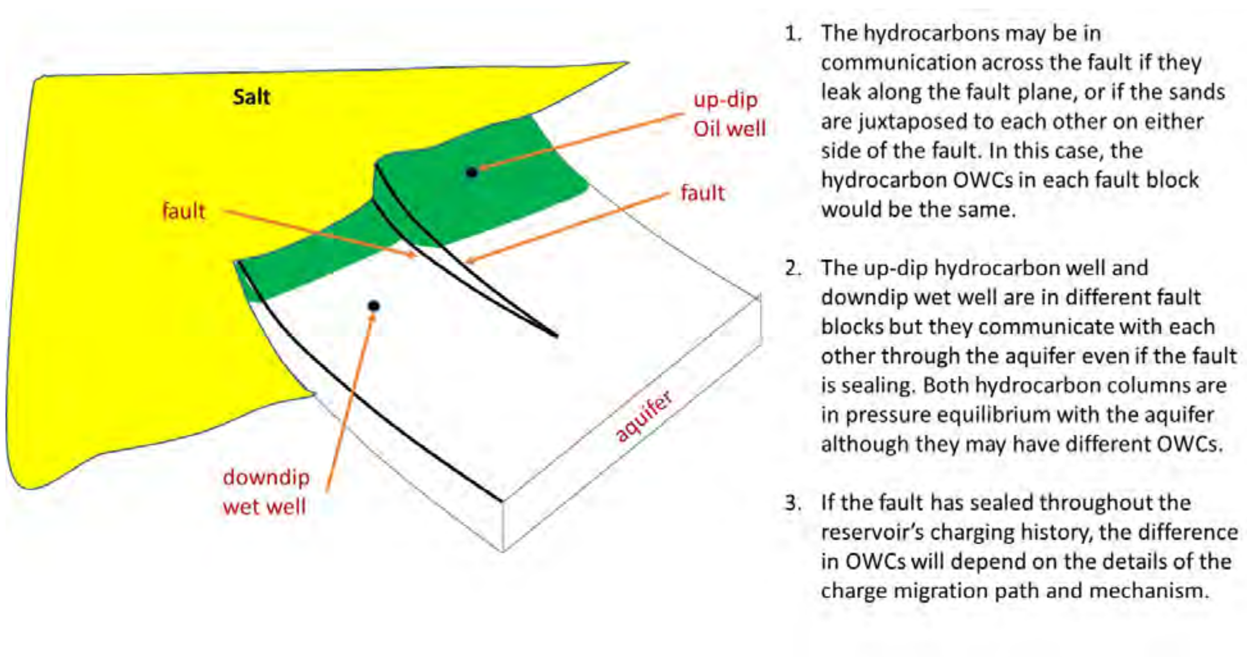


Figure 2 - A diagram of a "faulted horizon" where fluid contacts may or may not be at the same depth depending upon whether the fault is sealing or not. If the fault is non-sealing, the oil-water contact will be at the same level in both fault blocks.

128. Determining where a fault is located in the subsurface and placing it accurately on a map is primarily a function of the quality of the seismic data images produced from sound waves that are used to image the subsurface. The interpreted fault locations are then validated if a well penetrates them. In the case of Shenandoah, the poor quality of the subsalt images did not allow for confident placement of faults on a map. Inaccurate placement of faults on a map can lead to development decisions that would be suboptimal. Generally, the possibility of faults in a certain area is recognized and considered, but faults are only put on the map once adequately verified, for example where the sediment bedding offset can be recognized through interpretation of seismic

data, or from a well penetration. Whether a fault is sealing or not can seldom be determined with any accuracy unless common fluids and their pressures are measured on both sides of the fault, through fluid fingerprinting, or from production of the reservoir.

11. Fluid Pressure

129. Any column of fluid exerts a pressure along its column that is equal to the weight of the fluid above it.

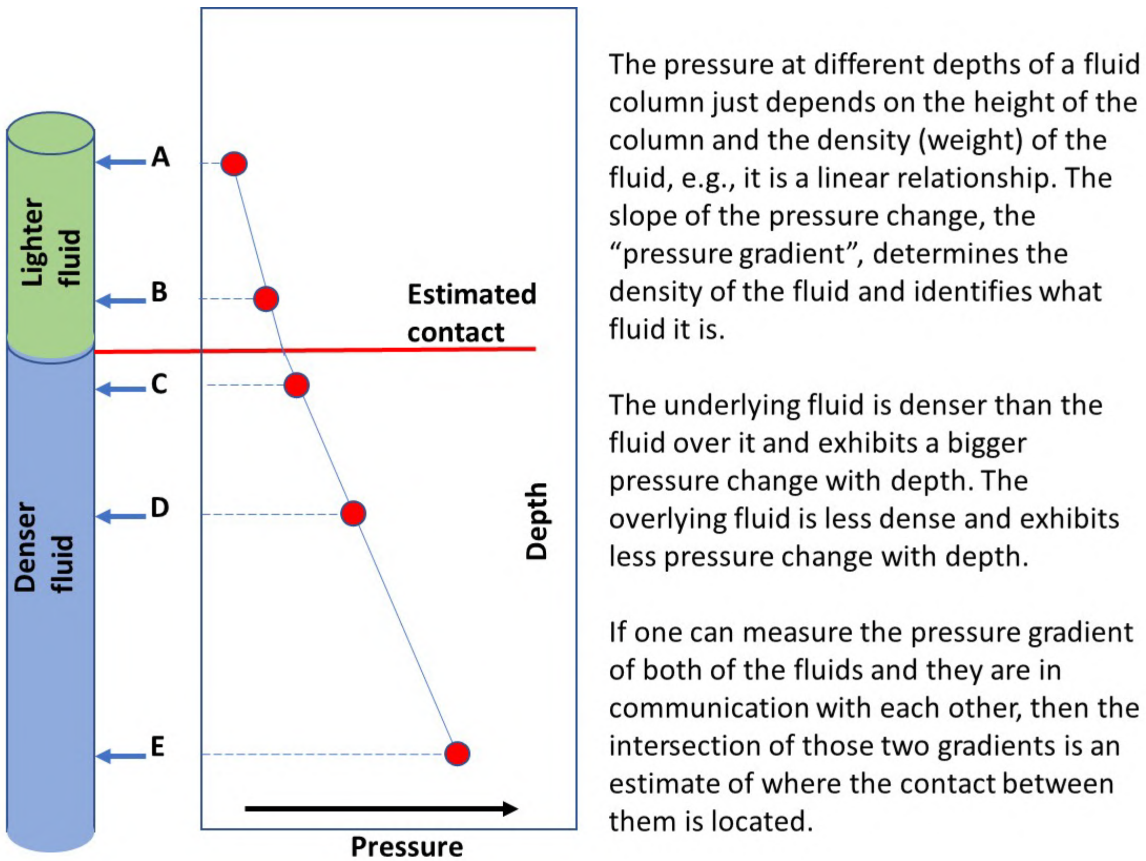


Figure 3 – An example of how different fluids exert pressure along their fluid column height which is indicative of their densities.

130. Pressure is transmitted through a reservoir via the fluid in the pore-space. For a trapped system in equilibrium, less dense fluids (gases and oils) are trapped above denser fluids (water) and are in contact at the gas-oil contact and oil-water contact, respectively. The pressure gradient up and down any fluid column is a direct measure of the fluid's density. Engineers can

project an OWC by measuring the pressure gradient of an overlying oil and intersecting it with the pressure gradient of the underlying water,[103] as depicted in **Figure 4** below:

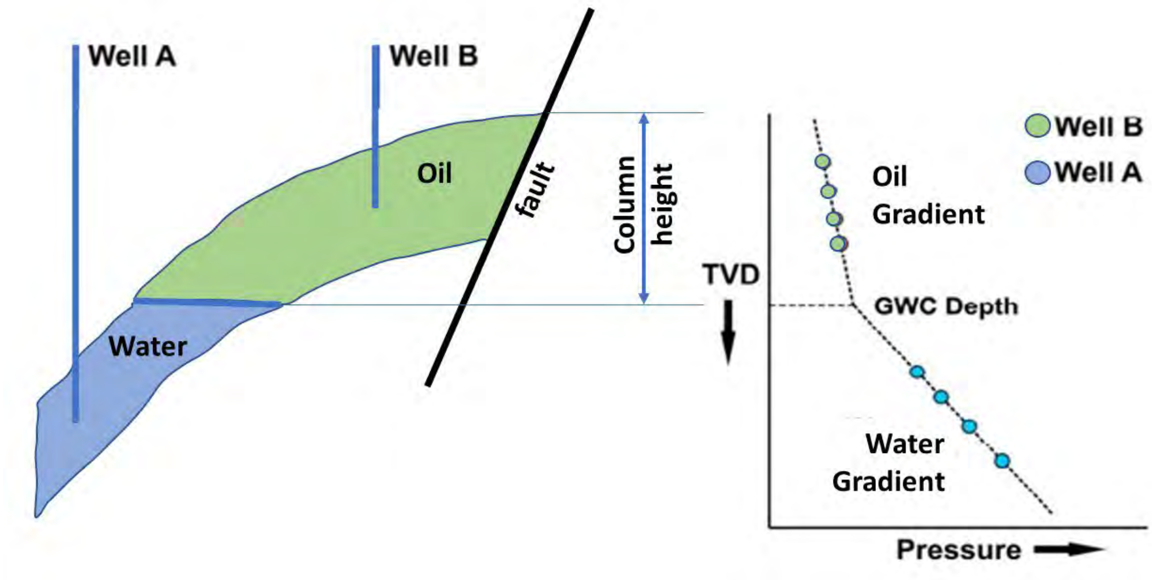


Figure 4 - Principle of fluid contacts identification by using formation pressure surveys. This example shows two wells that do not cross the oil-water contact, with the contact position estimated from the pressure gradients intersection.

131. Notably, this method works for any fluids between any two wells that are in pressure communication with each other. This is true where wells are separated by a fault, even when the fault is "sealing", as long as they communicate through their downdip aquifers. **Figure 5** below depicts this principle. In other words, data from different fault blocks *can* be used to project oil-water contacts even if they are separated by a "sealing fault" under the condition that they communicate through fluid pressures that connect them hydraulically somewhere.

132. Confusion sometimes arises because a "sealing fault" only seals between the fluids located on either side of it. A sealing fault can seal up-dip oil from moving across the fault and

[103] Petroleum Resources Management System – "Pressure Gradient Interpretations" (2018); B. Niculescu & C. Ciuperca, "Identification of Fluid Contacts by using Formation Pressure Data and Geophysical Well Logs" (July 2019):: SGEM 2019 (Vol. 19, 1.2), pp. 897–908.

give rise to different oil-water contacts on each side of the fault, but both sides can still be in pressure communication through a common downdip aquifer where the fault no longer exists or is non-sealing. If the fault were non-sealing up-dip, then the oil would move across the fault, giving rise to common oil-water contacts on each side of the fault.

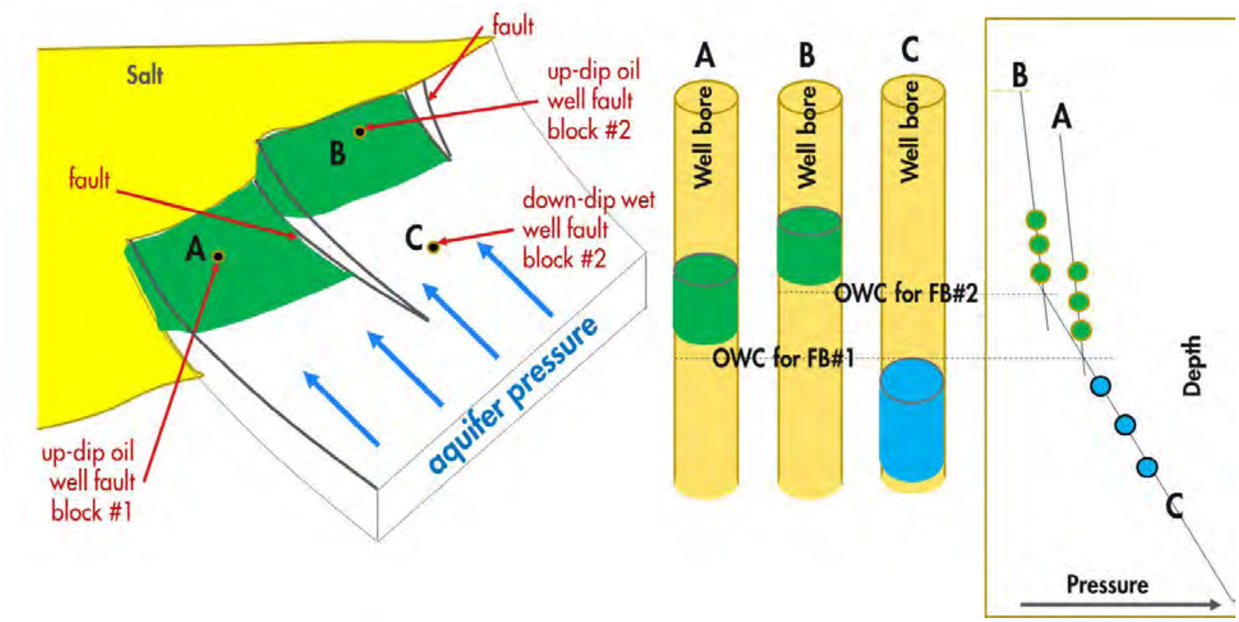


Figure 5 – Diagram showing how a sealing fault can give rise to different oil columns in each fault block but both fault blocks can still be in pressure communication with a common aquifer. This principle can be used to project an estimated OWCs for each fault block when no OWC has been penetrated with a well.

C. <u>History of GOM Development</u>

133. Oil and gas production in the Gulf of Mexico began in earnest in the 1970s, with the initial focus on plays in shallow water (less than 600 feet in water depth). Exploration activity targeted shallow, structural prospects (6,000–15,000 feet in depth below the surface), predominantly in open Plio-Pleistocene-aged basins (less than 5 million years old sediments), with oil and gas reservoirs often trapped against faults or against intrusive salt domes. Approximately 124 such discoveries were identified from 1975 to 2009 and, because they were in shallow water

and drilled to much shallower depths beneath the surface, these prospects could be developed with up to hundreds of producing wells each.[104]

134. As Plio-Pleistocene-aged prospects were depleted, older, Miocene-aged reservoirs (approximately 5 to 23 million years old) began to be targeted through exploration. These prospects are typically farther from shore, in deeper water (between 600' to ~7000' water depth),[105] and at deeper sediment depths (15,000' to ~25,000' below sea level). Approximately 125 such fields were identified between 1981 and 2018,[106] with initial discoveries tending to be in open sedimentary basins (*e.g.*, the Mars-Ursa field) surrounded by salt, as recent advances in seismic imaging of the day (3D seismic and true amplitude processing) made the exploration and development success rate acceptable. Because these prospects were further offshore, in deeper water and in deeper formations below the surface, these developments could not economically support large numbers of producing wells such as had been the case for developments in the Plio-Pleistocene-aged basins. Thus, these prospects were developed through sparsely located, high-rate wells (*i.e.*, wells capable of 5,000 to 30,000 barrels of oil per day each), and a premium was put on accurately locating each of these wells optimally

135. Through the development of these Miocene-aged reservoirs, it became clear that some hydrocarbon reservoirs extended beneath the large allochthonous salt deposits that overlie the Miocene in the Gulf of Mexico. These complications and challenges drove an increased demand for new types of seismic data acquisition and computer processing that could image the sub-surface below these thick salt deposits and allowed exploration and production activities to

---

[104] BOEM OCS Report 2021-005 at p. 67.

[105] Drillers.com – *Shallow, Mid to Ultra Deepwater Definitions*.

[106] BOEM OCS Report 2021-005 at p. 67.

explore in deeper and deeper water. As deeper wells proved that older depositional systems with economically producible hydrocarbons existed in deepwater Gulf of Mexico,[107] new plays, ultra-deepwater with water depths greater than approximately 7,000 feet of water and reservoirs 25,000 feet to 35,000 feet in depth, were pursued in the Paleogene (*e.g.*, the Lower Wilcox) and Jurassic (*e.g.*, Norphlet) (see **Figure 6** below). These plays test today's limits for seismic imaging and of development engineering technology for both temperature and pressure, and present significant economic challenges, given their costs and remoteness.

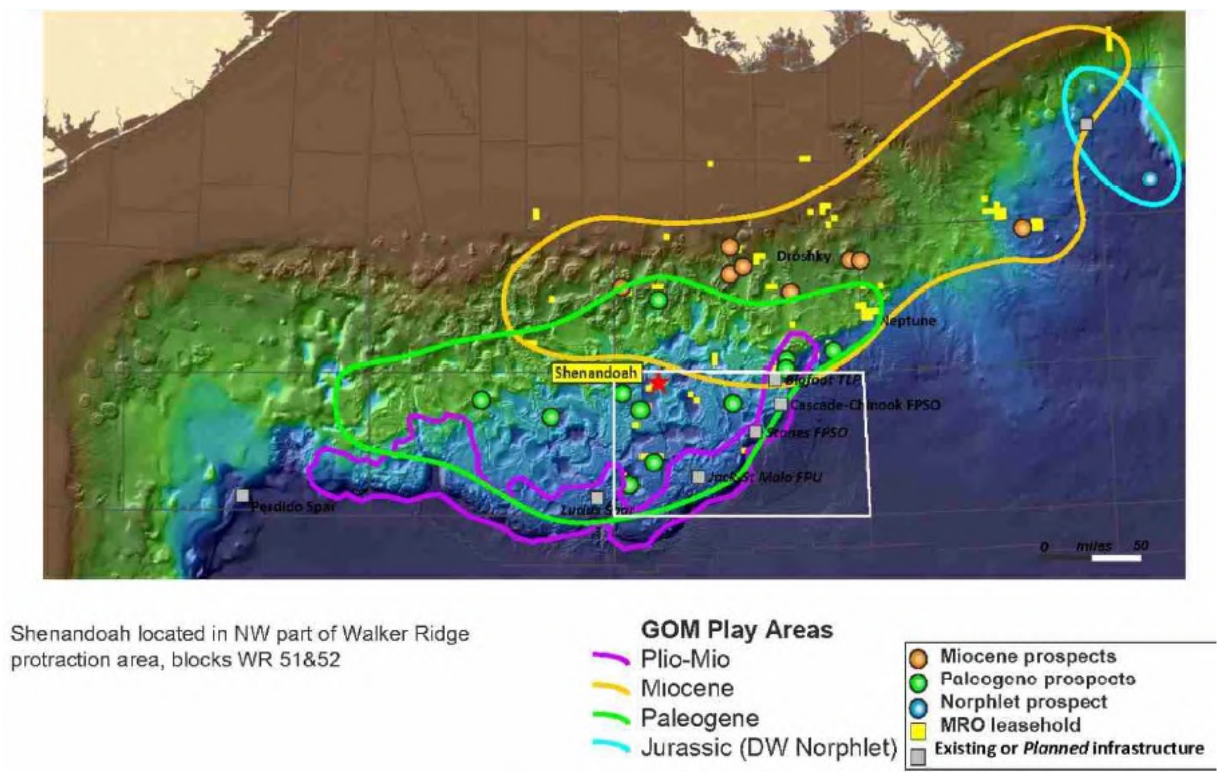


Figure 6 – Bathymetry map of deepwater Gulf of Mexico showing primary areas being explored in the Paleogene Plan (green) and Norphlet Play (blue).[108]

136. The below cross section (**Figure 7**) illustrates the relative ages, depths, and depths of water for these plays/prospects in the Gulf of Mexico.

---

[107] *Id.* at p. 1 (defining "deepwater" as anything greater than 1,000 feet in water depth).

[108] Marathon_014240 at slide 2.

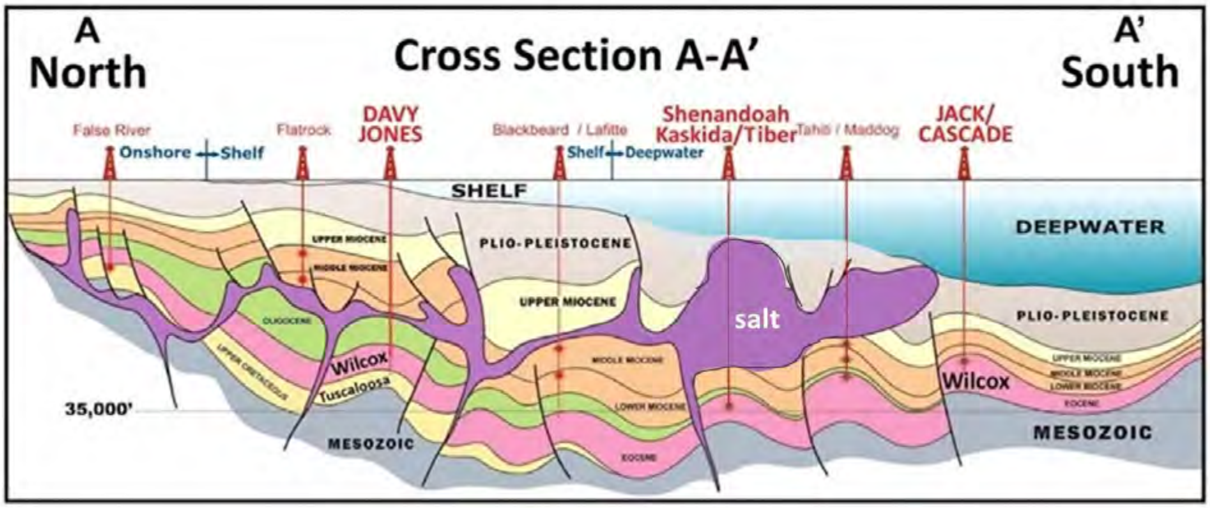


Figure 7 – Idealized structural cross section showing prospects and discoveries in the Gulf of Mexico.[109]

1. GOM Development Chronology

137. The history of Gulf of Mexico oil and gas exploration and production was most recently chronicled by the BOEM in their 2019 Report.[110] Highlights emphasizing the move to deeper water and older sedimentary play from the BOEM report are summarized below:

- "1947 – The first well out of sight of land was drilled in Ship Shoal Block 32 about 12 miles off the Louisiana coast in approximately 19 feet of water, marking the birth of the true 'offshore' oil and gas industry."

- "1975 – The first deepwater well was drilled by Shell in Mississippi Canyon Block 194 in 1,022 feet of water into Miocene turbidites, resulting in the Cognac discovery. The Cognac Field production utilized a fixed platform sitting on the seafloor and first production from it began in 1979."

- "1990 – The first subsalt discovery in deepwater was drilled in Mississippi Canyon Block 211 at the Mica Field in 4,356 feet of water."

- "1996 – The first Deepwater well to encounter Wilcox-equivalent, Lower Tertiary was drilled at the BAHA Prospect in 7,620 feet of water in Alaminos Canyon Block 600 beginning a new play in the Gulf of Mexico ultra-Deepwater."

[109] McMoran Exploration Q3 2009 Conference Call, modified by Art Berman.

[110] [BOEM OCS Report 2021-005 pgs. 6-9.]

- "2006 – The first commercial, wide-azimuth[111] seismic survey targeting improved subsalt imaging was acquired in deep water." Wide-azimuth seismic data improved imaging of subsalt structures by including sound echoes from the side-on view.

- "2010 – The first production from the Deepwater Lower Tertiary (Wilcox) Play began from the Great White Field (Alaminos Canyon 857). Production is collected at the Perdido Hub Spar platform. That year, the Macondo discovery blowout and explosion aboard the Deepwater Horizon drilling rig caused oil to flow into the Gulf of Mexico for 87 days before the well was sealed. A 5-month moratorium on all Deepwater drilling on the Outer Continental Shelf was declared shortly thereafter."

2. <u>History of the Deepwater Lower Tertiary Play in the Gulf of Mexico</u>

138. Key milestones in development of the Wilcox Play in particular are also documented by the BOEM.[112] Unlike the extensive history of Gulf of Mexico exploration, production and appraisal, the Wilcox Play has been pursued for only approximately the last 25 years. After proving a working petroleum system for the Lower Tertiary play in 1996 (Baha in 1996), it was 14 years before the first production from that play was realized (Great White in 2010). Highlights from this history include:

- 1996 – The first deepwater well to encounter Wilcox-equivalent, Lower Tertiary sediments was drilled at Baha prospect in 7,620 feet of water;

- 2010 – The first production from the deepwater Lower Tertiary (Wilcox) Play began from Shell's Great White field (discovered in 2002) in 8,717 feet of water;

- 2011 – The first Floating Production, Storage, and Offloading ship ("FPSO") in the Gulf of Mexico was utilized by Petrobras to produce Wilcox oil from Cascade and Chinook fields (discovered in 2002 and 2003);

- 2014 – The largest semisubmersible platform was installed in 6,950 feet for production of Wilcox oil at Chevron's St. Malo and Jack fields (discovered in 2003 and 2004);

- 2016 – Shell installs the Turritella FPSO in 9,560 feet of water to produce Wilcox oil from Stones field (discovered in 2005);

---

[111] Society of Exploration Geophysicists Wiki – *Wide azimuth*.

[112] *See* BOEM OCS Report 2021-005 pp. 7-9.

- 2019 – Chevron sanctions first 20,000 psi development for future production at the Anchor filed (discovered in 2014).

139. Between 1996 and 2018, 70 exploration wells were drilled to test the Lower Tertiary play in the Gulf of Mexico, and only 19 of them were deemed "developable discoveries" (*i.e.*, they encountered sufficient hydrocarbons to justify further appraisal and future development), just a 27% success rate.[113] Twenty-seven did not encounter producible hydrocarbons, and twenty-four encountered hydrocarbons but were appraised to be non-commercial. In addition, only those fields discovered before 2009 (10 discoveries) were currently developed and producing by 2019, giving a typical time from discovery to production for the Wilcox Play of 8 to 11 years.

140. The challenges of economically producing oil from the Lower Tertiary reservoirs in the Gulf of Mexico are considerably more complex than previous Pliocene, Pleistocene, and Miocene plays in the Gulf of Mexico. The vast majority of deepwater Lower Wilcox opportunities in the Gulf of Mexico lie underneath salt that has been mobilized and has moved over the top of the sedimentary deposition, making it difficult to fully evaluate these prospects and discoveries. The added complexity and extent of appraisal activities necessary for maturing a Lower Wilcox opportunity are well documented and known throughout the industry: "[C]hallenges include well depths of up to 35,000 feet subsea, water depths ranging from 4,000 to 10,000 feet, and salt canopies from 7,000 to more than 20,000 feet thick. Allochthonous salt covers 90% of the trend, complicating regional reconstructions and resolution of individual structures. Appraisal challenges include: delineating and modeling reservoir quality, sand distribution, and flow capability; improving complex sub-salt images; and developing cost effective drilling, completion, facility,

[113] *See* BOEM OCS Report 2021-005 Table 6, p. 71.

and infrastructure designs."[114] In order to ensure that investments to develop Lower Tertiary reservoirs are optimized, uncertainty in recoverable volumes must be reduced to an acceptable and manageable level. This can only be done through additional "appraisal" of the discovery, principally through appraisal drilling.

3. Anadarko History in the Gulf of Mexico

141. Anadarko had a long history of exploration successes and of operating developments in the deepwater Gulf of Mexico, beginning in 1984 with the Alabaster and Neptune/Thor fields and continuing through the 1990s with the Boomvang and Nansen fields. Anadarko participated as non-operating partner in a large number of deepwater Gulf of Mexico exploration wells, as well as being the operator in key strategic explorations tests when available. In 2000, Anadarko discovered and operated the Gunnison and Marco Polo fields in 3,000 to 4,000 feet of water.

142. From 2001 to 2007, Anadarko had a number of additional exploration successes in the deepwater Gulf of Mexico, including operating discoveries at Dawson (2001), Durango (2001), Navajo (2001), Pardner (2001), Red Hawk (2001), Merganser (2002), Atlas (2003), Constitution (2003), Jubilee (2003), Spiderman (2003), Cheyenne (2004), K2 (2004), Ticonderoga (2004), South Dachshund/Mondo (2005), and Power Play (2006).[115] Anadarko also announced significant exploration discoveries that it operated at Heidelberg (2009), Shenandoah (2009), Lucius (2010), Phobos (2013), and Yeti (2015). The Heidelberg and Lucius fields also proceeded to development and are now producing oil.

[114] J. Lewis et al., "Exploration and Appraisal Challenges in the Gulf of Mexico Deep-Water Wilcox," at p. 401.

[115] APC-01204634.

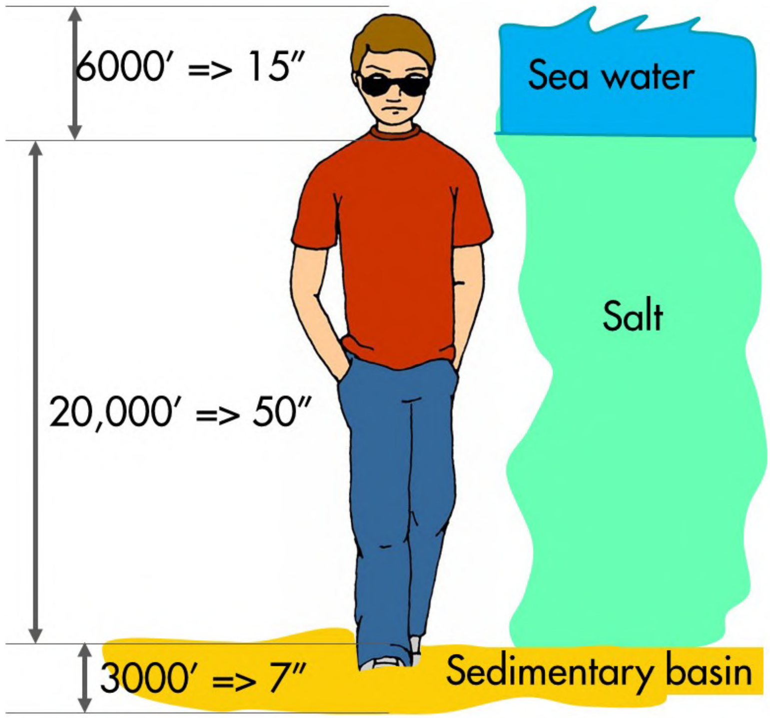
143. As with any exploration and production company, during this time, Anadarko also encountered exploration failures. These include failed discovery wells at the White Ash (2001), Lisa Anne (2001), Firestar (2009), Kakuna (2011), Spartacus (2012), Deep Nansen (2014), Bimini (2014), Music City (2018), and Sugar (2018) prospects. Additionally, a number of Anadarko's prior discoveries were deemed "non-commercial" based on appraisal efforts during this time, including at the Grand Cayman (2007), Andros Deep (2007), Norman (2007), Phobos (2017), and Warrior (2017) fields.[116]

144. These statistics in the Gulf of Mexico for Anadarko's exploration discovery success rate, and for Anadarko's ability to progress a discovery to development through the appraisal process, are similar to the industry's rate in the Gulf of Mexico. In other words, Anadarko, like most other oil and gas exploration and production companies operating in the Gulf of Mexico, was able to produce oil from just a small fraction of the total number of prospects that it explored.

D. Primary Challenges to Appraisal in the Gulf of Mexico

145. The scale of the challenges for appraising hydrocarbon accumulations in the deepwater subsalt Gulf of Mexico are difficult to appreciate unless one puts them into relation to familiar objects. **Figure 8** below scales the Shenandoah basin's depth to the height of a human for perspective:

[116] Anadarko 2009-2011, 2014, 2017-2018 10-K Filings.



Shenandoah dimensions scaled to human size.

1) The 30,000′ deep Shenandoah basin scaled to a 6′ tall human would put the water depth to his shoulders.
2) Salt would make up the majority of a human's scaled height.
3) The Shenandoah sedimentary basin would amount to a shallow child's sandbox at his feet.
4) A wellbore's thickness would scale to about 1/3 the diameter of a human hair.

Figure 8 – The Shenandoah basin scaled to the size of a 6-foot-tall human. The vast majority of the column consists of sea water and salt that has covered the sedimentary deposits that make up the basin's reservoirs.

1. Salt and Seismic Imaging

146. Anadarko's appraisal of Shenandoah was strongly influenced by the quality and availability of seismic data coverage. As explained above, a large amount of salt was deposited in the Gulf of Mexico when saltwater repeatedly flooded and evaporated over the area. Salt has very high seismic velocities (~15,000 ft/sec) compared to the sediments that surround it in the Gulf of Mexico (~6,000–12,000 ft/sec). This extreme velocity difference refracts the sound waves used for seismic imaging at the salt-sediment interfaces and makes proper imaging of seismic data through the salt extremely difficult. Sound waves get refracted by the salt at such extreme angles that recovery of a seismic image beneath thick salt requires acquiring data from very wide locations (wide-azimuth seismic data), and potentially from all possible directions (full-azimuth seismic

data). **Figure 9** below shows the 20,000-foot salt canopy in relation to the Wilcox sands that contained the hydrocarbons at Shenandoah, which combined were estimated to be about 3,000 feet thick at their thickest points.

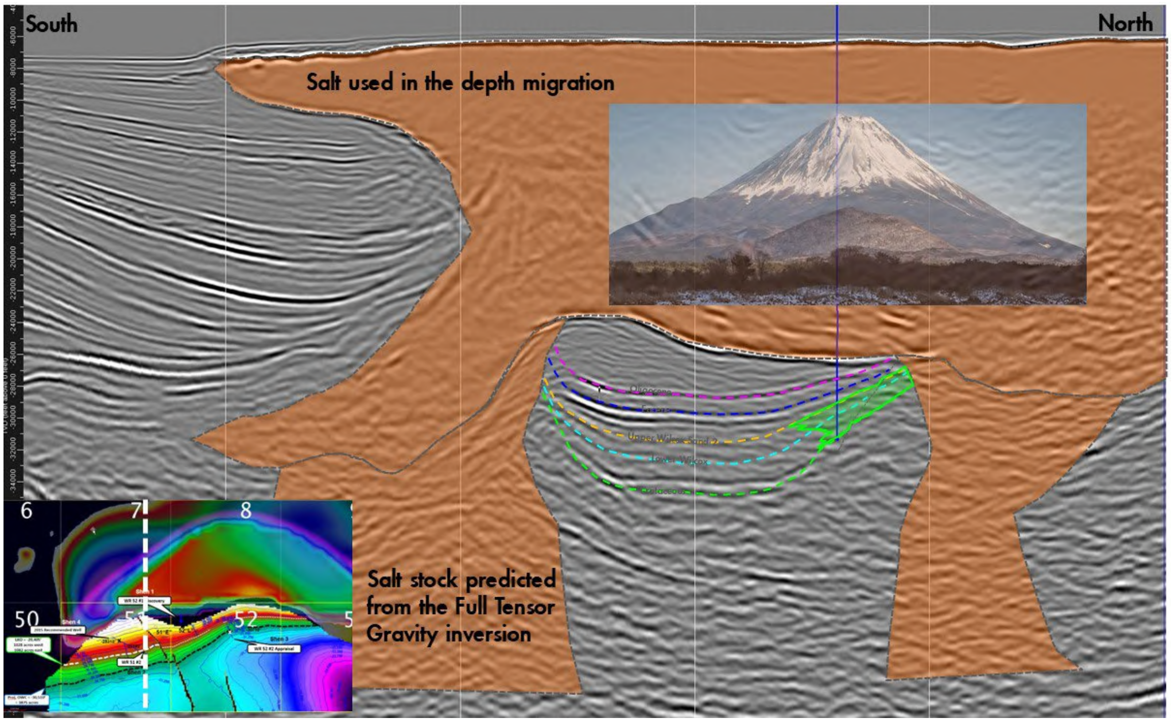


Figure 9 – Seismic image with interpretive overlay. The salt thickness (in brown) of 20,000 feet is referenced to Mt. Fuji which stands 12,388 feet high. The salt distribution is complex and contains imperfections and inclusions which distort the images of the sediment section underneath.[117]

147. At Shenandoah, the hydrocarbons are trapped adjacent to and beneath the salt to the west and north. There is also an overlying "salt canopy" that is physically located above the reservoir and that is approximately 20,000 feet thick, which makes seismic imaging of the underlying sedimentary basin extremely challenging.

148. Initially, the WesternGeco Wide-Azimuth "E-Octopus" seismic dataset (which was acquired starting in 2006) provided data for the early evaluation of the Shenandoah basin.

[117] APC-00001146 slide #69.

However, the imaging requirements for subsalt interpretation required an improved seismic acquisition method. This was then followed by WesternGeco's Full-Azimuth "Rev8 Coil" seismic dataset, which was acquired in 2010.

149. The Shenandoah partners incorporated each of these datasets into their analyses when they became available, but also reprocessed both datasets at La Compagnie Générale de Géophysique ("CGG"). The "E-Octopus Wide-Azimuth (WAZ)" reprocessing was delivered by CGG in 2011 and the "Rev8 Coil" reprocessing was delivered by CGG in 2016. Shenandoah partners also initiated an effort in 2015 to create a joint seismic image from the inputs of both seismic datasets, which was delivered in 2017:

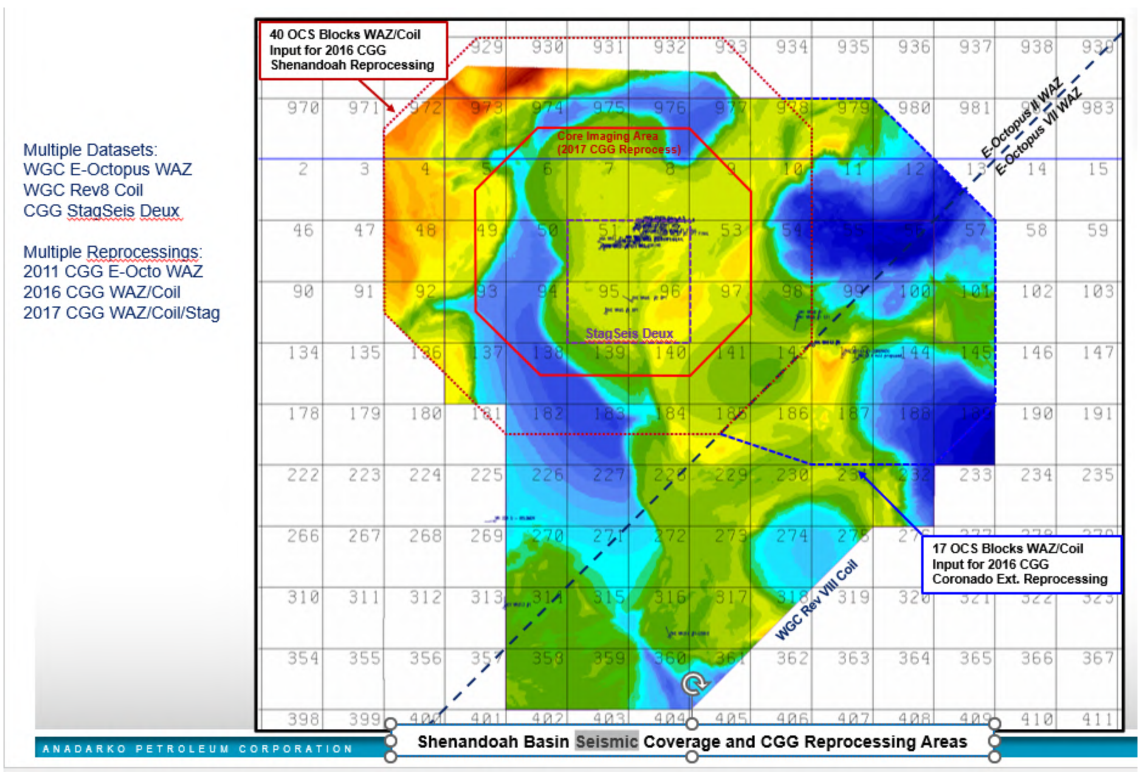


Figure 10 – Map showing the 2017 seismic coverage available over the Shenandoah discovery.[118]

[118] APC-01314375 at slide 45.

CONFIDENTIAL

150. Each version of the seismic image of the Shenandoah discovery provided new insights, but each had its own limitations and issues, including limitations associated with deriving the correct velocity model, especially anisotropic sediment velocities, issues with interfering noise from multiples,[119] and issues associated with accurately predicting the depth of these images from seismic data recorded only by the sound waves' travel time. Thus, although collection and reprocessing of seismic data improved Anadarko's ability to map the Shenandoah field over time, the identification of subtle features in the underlying sedimentary section, such as faults, remained difficult throughout the project.

2. Unclear Views on the Hydrocarbon Migration Pathways and Filling Sequence

151. Understanding the charge migration into the Shenandoah trap is important for understanding the extent and possible distribution of oil in the reservoirs.[120] Unfortunately, the quality of data that the Shenandoah partnership had available made understanding the migration of hydrocarbons at Shenandoah difficult.

152. The movement path of oil from its "source" into the Shenandoah trap was originally proposed by Anadarko's Exploration team to be via the deep basin center, with migration up from basin center through the reservoir sands into their current trapping position:

[119] J. Lewis, et. al., "Exploration and Appraisal Challenges in the Gulf of Mexico Deep-Water Wilcox," p. 401.

[120] AAPGWiki – *Hydrocarbon Migration*.

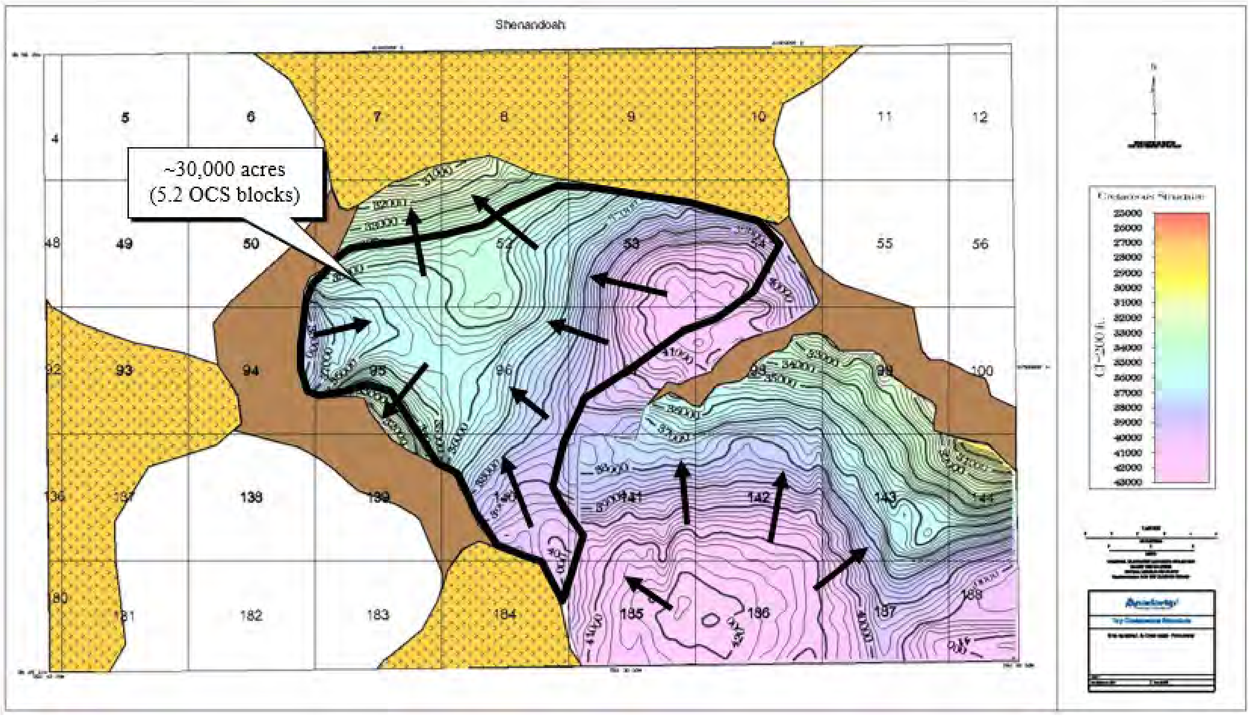


Figure 11 – Anadarko Exploration interpreted the oil at Shenandoah as having migrated from the deeper parts of the basin, filling all traps to their spill-point if enough charge was available.[121]

153. In this model, the oil penetrates the rocks between the source and reservoir in the basin center via "capillary pressure" and remains trapped in the Lower Tertiary reservoirs up to their seal capacity: "As hydrocarbons begin to migrate into a rock, displacing the pore water, the hydrocarbons first enter the pores with the largest pore throats (capillaries), leaving [residual] water in the pores with smaller throats or in small nooks and crannies (surface roughness). As the hydrocarbon column increases, the height above the surface where Pc = 0, called the free surface or free water level (FWL), becomes greater and the capillary pressure increases, allowing hydrocarbons to enter pores with smaller and smaller throats. This process continues until one of several things occurs: generation or migration ends, or the trap reaches its spill point, or the

[121] APC-01669692 at slide 29.

capillary pressure is sufficient to force hydrocarbons into the seal (displacement pressure is exceeded), allowing the seal to leak."[122]

154. This proposal drove a belief that the Shenandoah trap, and any of its potential fault blocks, would be equally likely to receive oil charge, and, if enough charge was available, and if the seals were adequate, would fill the entire trap to its capacity. It is this understanding that was used to estimate potential OWCs until data that indicates otherwise from appraisal wells becomes available (either penetration of OWCs or up-dip/downdip pressures to project OWCs). This drove the interpretation of early OWC estimates before pressure data from the Yucatan-2 and Shen-3 wells indicated otherwise.

155. However, oil migration also "occurs along discrete pathways, not along broad, uniform fronts."[123] A common industry understanding is that "petroleum from the source rock migrates vertically to the first regional seal above it and is deflected laterally as shown by the flow lines interpreted on the base of that seal. At the limit of that seal or at holes in that seal, the petroleum is assumed to migrate vertically until it once again becomes constrained by a seal. In this way, the petroleum is seen to stairstep up the section. It migrates below intermediate regional seals and possibly fills intermediate traps until it is finally constrained below a master sealing section, if one is present . . . . Faults can be considered as either non-sealing (the flow lines go up-dip right through them) or sealing (they divert the flow of hydrocarbons around them)."[124]

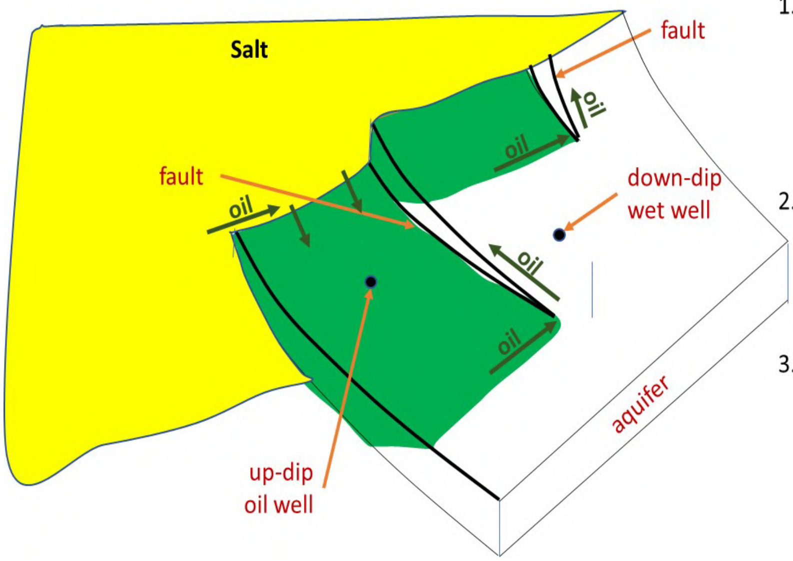
156. In the case of Shenandoah, the "master seal" is the overlying salt. Therefore, another "charging model" for Shenandoah could be the charging of the fault blocks from oil

[122] AAPG Wiki – *Capillary Pressure*.

[123] AAPG Wiki – *Migration Pathways*.

[124] *Id.*

migrating along the salt-sediment interface and filling the reservoirs from the top down. If the faults were to seal in this model, the oil would "fill-and-spill" from one fault block sequentially to the next adjacent fault block. Charge could fill and spill from one fault block to another in a multitude of ways.



1. Oil migrates along salt-sediment interface (from left-to-right) until it reaches first reservoir and fills it from the top. (If the fault is not sealing, then both fault blocks charge with the same OWC.)
2. If the fault is sealing, the oil fills the first fault block and then spills at the tip of the fault and begins filling the second fault block.
3. This process continues until the charge is exhausted, or all fault block traps are filled and any remaining charge spills elsewhere.

Figure 12 - Model describing an oil charging method of "fill-and-spill" as oil migrates from the top and side and sequentially fills fault blocks from east to west.

3. High-pressure Environments and 20,000 psi Technology

157. The production of oil and gas from Shenandoah basin would require design, construction, and certification of equipment suitable for the pressures measured in the reservoir. Specifically, the pressures at Shenandoah were greater than the 15,000 PSI-rated blow-out prevention equipment that had been approved for drilling in the Gulf of Mexico at the time Shenandoah was being appraised.[125]

[125] APC-00000671 slide #3 ("Current mudline SIP suggests production and completion equipment rating > 15KPSI").

158. The Blowout Preventer (also referred to as "BOP" or "BOP stack") "is the assembly of drilling-control equipment connected to the top of the casing head."[126] Blow-out prevention equipment is a safety requirement for both drilling and production as it serves as the last line of defense for ensuring that hydrocarbons do not escape uncontrolled from a well. In Deepwater, during drilling, the BOP is located at the seafloor attached to the casing head. During production, the well control stack may be located at either the seafloor (wet tree) or on the Production Platform (dry tree).

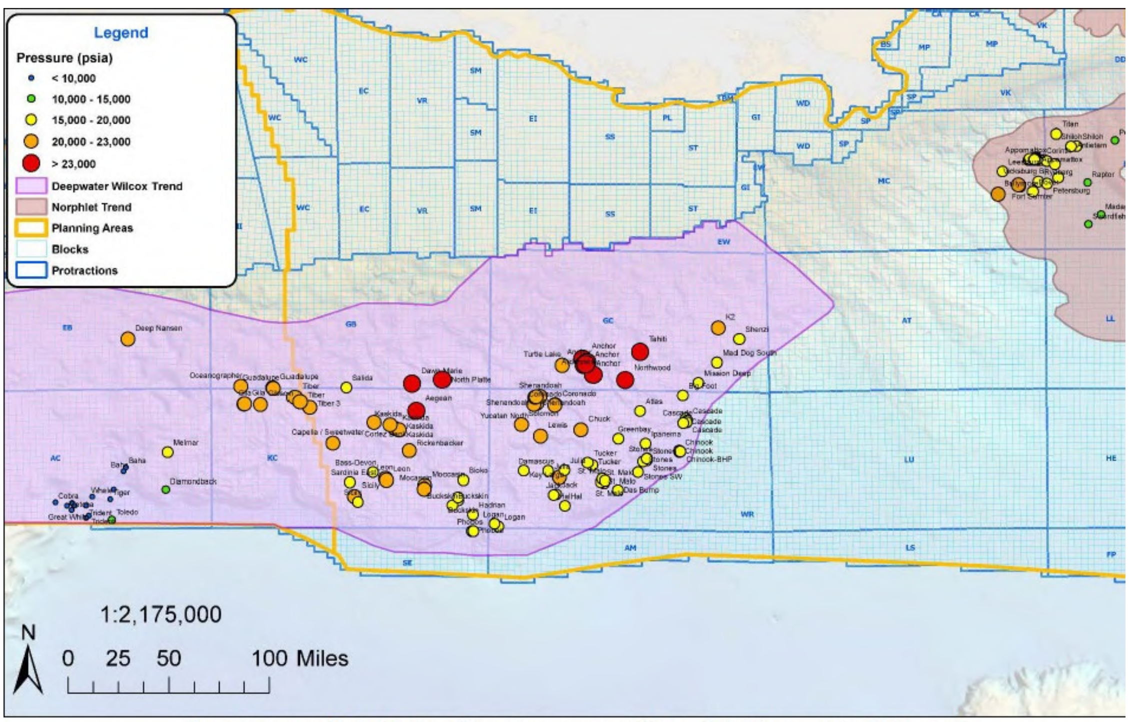


Figure 69. Geographic distribution of formation pressures at the top of the Wilcox and Norphlet Formations.

Figure 13 - Formation pressures at the top of the Wilcox formation[127]

159. At the time of Shenandoah's discovery, 15,000 psi BOPs and "wet trees" were the highest pressure available offshore control equipment available. In order to successfully drill the

[126] ScienceDirect,

[127] BOEM OCS Report 2021-005, p. 82.

CONFIDENTIAL

Shenandoah wells, which encountered pressures well in excess of 15,000 psi, dual BOP stacks and compatible drilling rig modifications were employed. However, the development of deep, high pressure, high temperature reservoirs in the Gulf of Mexico would require 20,000 psi equipment. A number of companies with discoveries in excess of 15,000 psi began to pursue industry solutions.

160. However, the Macondo blowout in 2009 substantially limited all drilling in deepwater Gulf of Mexico and set the stage for new requirements for BOPs, causing delays in the rate of development of 20,000 psi technology.[128]

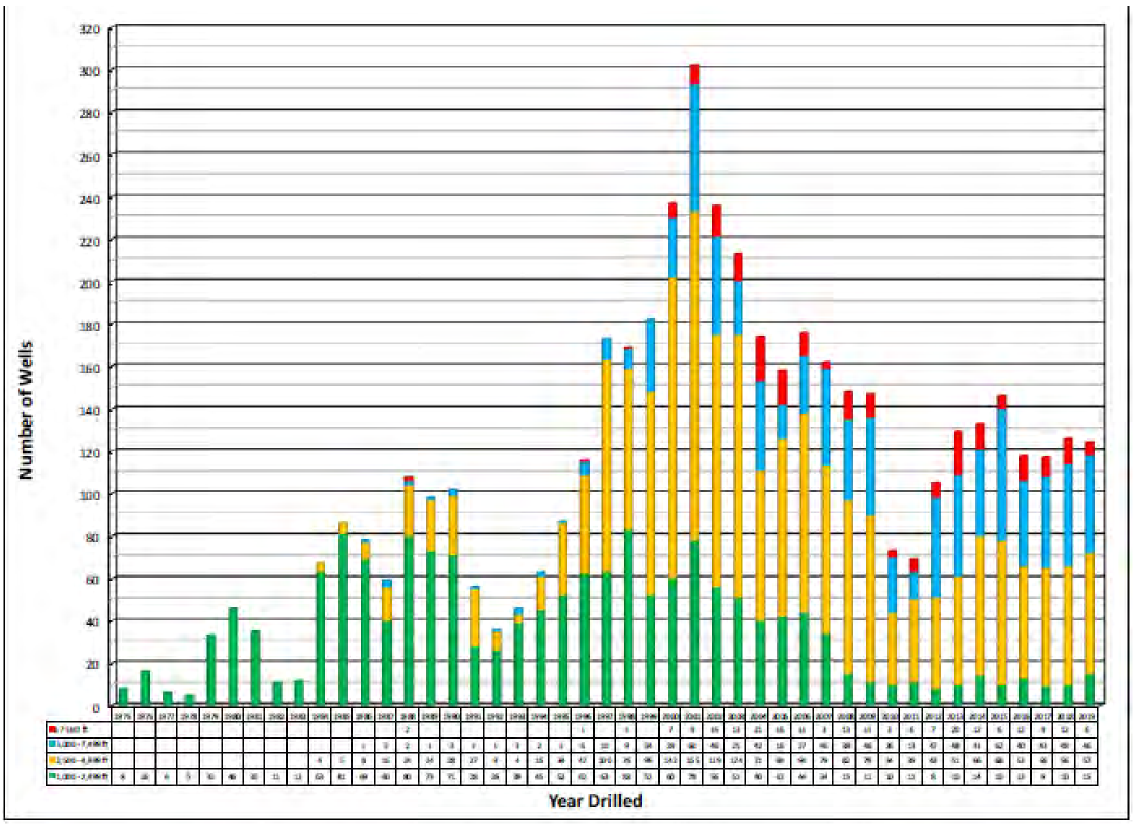


Figure 57. Number of deepwater wells drilled by water depth.

Figure 14 – BOEM documentation of the number of deepwater wells drilled per year in the Gulf of Mexico color-coded by water depth. As shallower opportunities were depleted and as

[128] BOEM OCS Report 2021-005, p. 62.

technology advanced drilling and production capabilities, the ability to pursue deeper water targets increased.[129]

161. After the BOEM issued its new requirements in 2011, companies moved to advance the 20,000 psi technology development. For example, in 2013 British Petroleum "announced Project 20K, a multi-pronged research and development program 'to develop, by the end of the decade, the technologies to be able to drill, complete, produce, and intervene in deepwater reservoirs that have (pressures of) 20,000 psi at the mudline.'"[130]

162. The certification process for this offshore equipment can take a considerable length of time and has manufacturing hurdles but bears little technical risk of failure.[131] Offshore equipment has been designed, built, and certified in incremental standards over the last 100 years (*e.g.*, 10,000 psi in 1920s, and 15,000 psi in 1980s).[132]

163. The Shenandoah partners recognized that this next level of high-pressure equipment would be required to develop Shenandoah economically, and Anadarko established the "20A Project" to move this technology forward.[133]

164. This challenge is well characterized as follows:

> "As the industry moves closer to the deployment date for the first blow-out preventers (BOPs) rated to withstand pressures of twenty thousand pounds per square inch (20kPSI), there is a notion that these new BOPs are 'the same thing, just bigger.' While technically correct, this vastly underestimates the true impact of this new technology on the entire drilling system. Ensuring successful drilling

---

[129] BOEM OCS Report 2021-005 p. 62.

[130] Offshore Magazine, "Project 20K Aims to Unlock HP/HT Deepwater Reserves", Nov. 12, 2013, https://www.offshore-mag.com/deepwater/article/16761226/project-20k-aims-to-unlock-hpht-deepwater-reserves (quoting BP's Project 20K leader in Houston).

[131] APC-00000671 at slide 31.

[132] IADC Drilling Contractors, "Lessons Learned from Qualification of 20,000-psi Subsea BOP Stack," May 12, 2020.

[133] APC-00129874 at slide 22.

> campaigns with 20kPSI well control systems require a new approach to specification, acquisition, operation and maintenance procedures.
>
> A higher-pressure rating requires thicker bodies and bigger rams, which lead to an increase in weight. OEMs may need to implement changes to material characteristics and design parameters to mitigate the weight increase, but the increase in size also impacts the BOP Control System in terms of control fluid pressure, flow rate, and volumetric capacity. Additional sensors and software will be required to monitor and control the more complex system.
>
> The design impact extends to other equipment on the rig that interfaces with the BOP, including the Riser System, Choke Manifold, Tensioners, Riser Handling, BOP Handling, pressure testing equipment, and contingency systems such as Capping Stacks. The 20kPSI BOP is now an integrated system of equipment, controls and supporting infrastructure. Ensuring this new system meets the safety and performance requirements of the drilling campaign requires a new approach to the processes that define the way equipment is operated and maintained, as well as the competencies and skills of individuals in charge of the equipment."[134]

Such equipment has recently become available in the oil and gas industry and has been identified for deployment at deepwater developments, such as by Chevron at its Anchor project[135] and by Beacon Offshore at Shenandoah.[136]

E. Technical Disputes at Shenandoah

1. Anadarko Exploration and Development Teams had Differing Missions

165. The dispute between Exploration and Development teams was the result of different team missions.

166. Based on my over 40 years of experience in the oil and gas exploration and production industry, I am very familiar with differences between exploration and development teams. Exploration teams across the industry are almost universally focused on determining, for any particular prospect, how big it could be. This perspective is inherent in the function of any

[134] Athens Group Maritime Energy, "Preparing for a Successful 20kPSI BOP Campaign," Dec. 2015.

[135] Chevron Announcement, "Chevron Sanctions Anchor Project in the Deepwater U.S. Gulf of Mexico," Dec. 2019.

[136] Oil & Gas Journal, "Beacon Offshore Advances Ultra-deepwater Shenandoah Project," Sept. 2021.

company's exploration group, which is tasked with finding new hydrocarbon deposits and proving that there is enough potential resources to transition the project to a development team that will determine whether to invest considerable capital in developing the prospect for production. Conversely, development teams across the industry are typically tasked with determining whether the uncertainties of a project have been reduced sufficiently to state with confidence that the project has reached the "minimum economic field size"—*i.e.*, that the company will make a profit by investing in the infrastructure necessary to produce oil from that prospect. In general, these differences in the fundamental task of each team leads exploration teams to emphasize the upside potential of prospects, which are successful discoveries (as noted above, the majority of exploration wells *do not* encounter producible hydrocarbons at all), while development teams tend to focus on the risks posed by the remaining uncertainties at any particular prospect.

167. Through my review of documents and deposition testimony in this action, I believe many, if not all, of the differences in opinion between Anadarko's Exploration and Development teams for Shenandoah can be attributed to this difference in team mission. Differences of opinion between teams such as these are very common in the oil and gas industry and are important to maintaining a balanced view of an opportunity that carries considerable risks and uncertainties.[137] In my opinion, these differences in opinions between Anadarko's Exploration and Development teams at Shenandoah were likely not different than they would have been for many given prospects at any given oil and gas exploration and production company. While I detail some of the particular manners in which the Anadarko Exploration and Development teams differed with respect to the Shenandoah appraisal, in general my opinion is that both teams' interpretations of the available

[137] *See* Morris Dep. Tr. 132:13-16 ("It's an observation as old as time that geoscientists tend to be optimistic-minded. And we have to be careful that we don't get too optimistic with our low-side estimates.").

data at Shenandoah were reasonable and that no particular team was "right" or "wrong" with respect to their assessment of the discovery.

2. Anadarko Exploration and Development Teams had Differences in Mapping Techniques and Styles

168. The Anadarko Exploration team's initial mapping was driven strongly by seismic interpretation and was limited in its identification of sediment features (*e.g.*, onlaps, thinning, faulting) due to the early seismic data's lack of imaging resolution beneath the thick, overlaying salt. Exploration's focus was on determining the potential size of the resource and the amount of oil in-place. Anadarko's Development team, meanwhile, only became actively involved with the discovery after the success at Shen-2, and at a time when improved seismic data became available. The Development team also performed initial scoping of a range of potential development scenarios, recognizing the possibility of separate compartments within the reservoir,[138] and the impact that might have on oil recovery. Given the range of uncertainty in recovery that they observed, the Development team focused on proving a minimum economic filed size that an optimum development scenario could be designed for.

169. By May 2014, the Anadarko Development team had already completed its own seismic mapping of the Shenandoah reservoirs, identifying several "potential" faults that could be inferred from subtle changes in dip of the mapped horizons, as shown in the below **Figure 15**.[139]

[138] APC-00000671 at slides 3, 31.

[139] APC-00001466 at slides 28-32.

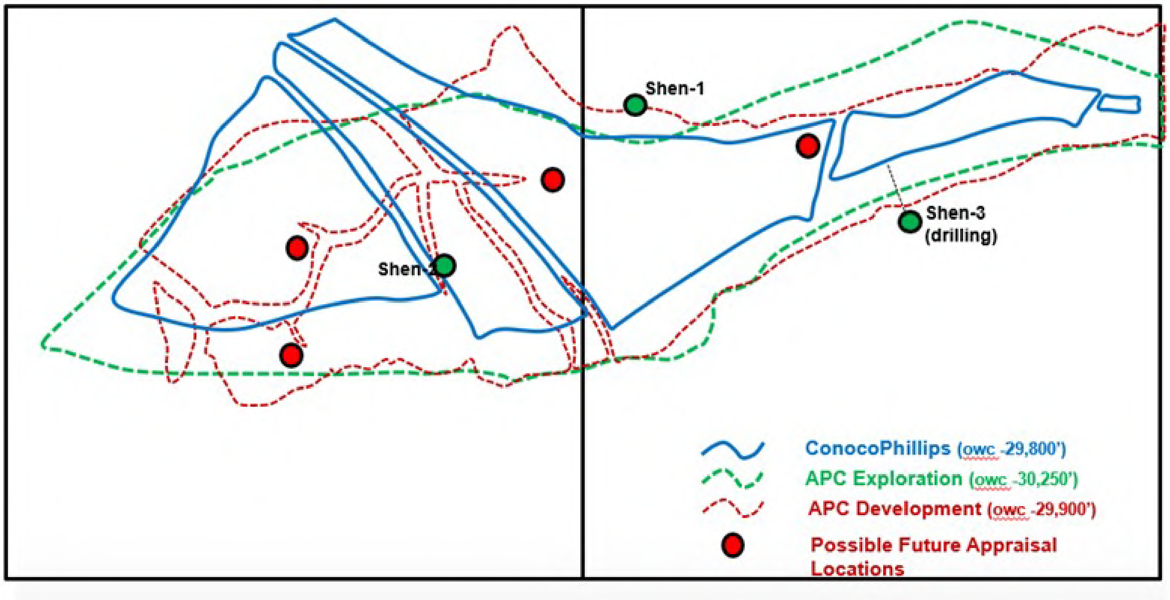


Figure 15 - Comparison of Anadarko Exploration, Anadarko Development, and ConocoPhillips teams' mapped outline of Shenandoah top of Upper Wilcox. Anadarko's Exploration team has not interpreted faults where Anadarko Development and ConocoPhillips team have interpreted a variety of faults. However, each team has mapped a similar extent including the up-dip northern extent trapped by the salt, the extensive eastern area in trap, and similar OWCs that are minimally influenced by the possible faulting.[140]

3. Anadarko Exploration and Development Teams had Different Methodologies for Calculating Recoverable Volumes

170. Exploration took a straightforward approach towards volumetrics, as they simply estimated P10 and P90 areas and net thickness for each reservoir, applied an estimated recovery factor, and added all of the reservoirs together. They did this using Rose & Associates' Multi-Method Risk Analysis ("MMRA") software to make probabilistic calculations assuming log-normal distributions for each of the values.[141] In this way, their P50 volumes were determined from their P10 and P90 inputs. They also focused primarily upon the uncertainty of calculating

[140] APC-00001466 slide #32.

[141] APC-00002093; APC-00002201.

the "volumes in place" and "scaled" these volumes to what was recoverable by applying a "yield factor"[142] that accounted for their estimated recovery factor.

171. Anadarko's Development team focused more on reservoir simulation,[143] further defining downside areas and accounting for the uncertainties associated with recovery factors. Their recoverable volume estimates depended strongly upon the details of the connected subsurface oil compartments (whether faults were sealing or not), the size and connectivity of the reservoir to the aquifer (larger aquifers improve recovery),[144] and the number of development wells planned (more wells being associated with recovering more oil).[145] As the appraisal program progressed and additional compartmentalization was demonstrated (Shen-2 not connected to Shen-1; Shen-4 not connected to Shen-2; Shen-5 not connected to Shen-2; etc.),[146] the estimated recovery factors and associated volumes that the Development team calculated diverged from those numbers that the Exploration team's methodology previously delivered.

4. Anadarko Exploration and Development Teams had Different Opinions of the Significance of Mapped Faults

172. The Anadarko Exploration team tended to incorporate only "high confidence" faults into its maps, viewing significant uncertainty about whether any such faults existed, where they were, and whether or not they provided a seal that would inhibit recovery across the fault.[147] Exploration team members had a strong appreciation for the limits of interpretation of the seismic data, which was reasonable because the sub-salt seismic images of the Shenandoah basin

[142] Net recoverable barrels ("bbls") per net-acre-feet.

[143] APC-01166304 at slide 7.

[144] *Id.* at slide 8.

[145] *Id.* at slide 7.

[146] *Id.* at slides 16-19.

[147] APC-00000959 at slides 11-14.

sedimentary section were contaminated by noises and imaging difficulties. The Exploration team members understood that the resolution of the data did not allow for identifying faults seismically with a high degree of accuracy and chose to only interpret a fault when it was necessary to explain the data collected in appraisal wells. They were also aware of the fact that no matter how faults were mapped, it would always take more than one well to produce the field, and that development wells could be positioned appropriately to recover most of the resource.[148] This viewpoint was reasonable absent the demonstration of extensive sealing faults, which would create numerous small compartments and make a large number of wells necessary to recover economic volumes, impacting development costs. As noted above, until late in the appraisal program (after Shen-4), the number of faults interpreted by partners was minimal and the differences in recovery volume estimates were being driven by differing estimates of area and recovery factor.

173. The Anadarko Development team began its mapping on a significantly improved seismic dataset (WesternGeco full azimuth "Coil" dataset) and used an interpretation technique already demonstrated by ConocoPhillips interpreters to identify potential faults using the dip of their structure maps.[149] Geophysicists knew that these changes in dip could also be caused by a variety of noises and other overburden issues, and when combined with uncertainty in fault sealing capacity, were carried on maps with a minimal level of impact.[150] Unfortunately, these changes were only clearly defined seismically in an area downdip of any potential oil accumulation or well control, and interpretation of these faults at reservoir levels required interpretive extrapolation into the up-dip oil areas.

[148] APC-00000959 at slides 12-14.

[149] APC-00001048 at slide 20.

[150] ANACOP00005209 p. 4.

174. This method gave rise to a large number of "lineaments," which the Anadarko Development team carried on its maps as potential faults. As appraisal drilling progressed and oil levels and pressure data became available, some of these lineaments became "agreed upon" faults, such as the fault between the Shen-2 and Shen-5 wells.[151] In other cases, no "lineament" was recognized or fault interpreted, such as between Shen-5 and Shen-6; that fault was only mapped after Shen-6 was drilled and encountered water-bearing sands, implying there must be a fault between those wells.[152]

5. <u>Differences of Opinion Regarding the Shenandoah Appraisal Were Driven by Differing Objectives of the Exploration and Development Teams</u>

175. Exploration was focused on identifying the largest recoverable volumes to drive the development decision and, as a result, continued to target appraisal wells that tested the extreme limits of the extent of the Shenandoah trap (*e.g.*, Shen-3 tested far downdip OWC,[153] Shen-4 tested far western up-dip limit against salt,[154] and Shen-6 tested up-dip eastern extent[155]). Each of these appraisal tests was risky but would ensure that if Shenandoah were a large field, that it would be defined and recognized as such.

176. Development was focused on optimizing the economic value of the Shenandoah discovery, which meant creating a development plan of appropriate scale to ensure maximum value achieved relative to the use of capital.[156] This process is much more exacting and requires detailed subsurface and development models. Since spending too much capital to develop a field

[151] APC-00001466 at slide 32.

[152] APC-00259884 at slide 7; APC-01288467.

[153] APC-00000907 at slide 7.

[154] APC-00001935 at slide 5.

[155] APC-01229949 at slides 26-27.

[156] APC-01229949 at slide 22.

will destroy profitability, Development estimates, by their very nature, are relatively conservative. Incremental resources that are non-economic to develop and produce (*e.g.*, oil up-dip of an existing well, or oil in a fault block whose recoverable volume is too small to support the costs of the developing well, etc.), are excluded from their estimated recoverable resources.[157]

[157] APC-01288761 at slides 7-11.

V. REBUTTAL TO MERRILL'S AND PITTINGER'S FOUNDATIONAL INFORMATION

A. Rebuttal to Merrill "Relevant Geological Background"

177. **Merrill ¶ 29:** "As sediment accumulated, upward-flowing salt deforms the margins of the deposit. As the salt substrate moved laterally and vertically, the overlying sediment distorted, causing faults and fractures. Today, we find sedimentary subbasins isolated by vertical salt diapirs feeding the salt canopy. Shen is one of these subbasins. In these subbasins, one would expect to find variable sediment thickness across the basin away from turbidite channels, lateral pinching out of individual sands, faults, fractures, and deformation bands caused by differential movement within the sediment column."

178. **Rebuttal to Merrill ¶ 29:** Merrill is describing an in-place basin that was subsequently deformed by post-deposition salt movement. The evidence at Shenandoah indicates that the turbidite deposition occurred synchronously with the salt movement until the salt flowed out over the seafloor and covered the basin. The evidence of this is the continuity of correlative depositional layers of the sediment layers across the basin and the relatively flat base of salt covering the basin. Merrill is correct in noting that one would expect "variable sediment thickness across the basin" as the center of the basin should hold thicker sediment deposits and the edges should thin, representing the expanding accommodation space during turbidite deposition. One might expect some faulting and/or deformation bands in the basin due to compaction and basin subsidence. However, there is little evidence that the basin continued to deform after it was covered by salt or that any significant faulting was caused because subsequently the "salt substrate moved laterally and vertically." This interpretation is consistent with the diagram that Merrill

references in Figure 5 of his report that shows little to no subsequent deformation of the basin once it is deposited and the salt canopy forms.[158]

179. **Merrill ¶ 31:** "Sediment deformation caused by vertically migrating faults creates faults in the sediment. When the salt meets an overlying resistant bed, it spreads laterally, forming the canopy."

180. **Rebuttal to Merrill ¶ 31:** In my experience with deepwater salt canopies, the vertically moving salt does not create additional "vertically migrating faults," but rather takes advantage of existing fault structures as areas of weakness into which salt can more easily flow. Also, salt seldom "squeezes" itself between two competent sediment layers, as Merrill implies.[159] Rather, the salt emerges at the seafloor and flows rather easily over adjacent sediments, and then perhaps is deformed again by even later sediment deposition that occurs on top of it. The basin may deform at the edges due to autochthonous salt moving away from underneath the basin, creating additional subsidence of the basin. However, if the salt continues to evacuate from under the sediment in a salt covered basin, the base of any overlying allochthonous salt will also deform.

181. **Merrill ¶ 32:** "As the salt moves laterally, the overlying sediment collapses differentially. The basin formed by this collapse, such as the Shen basin, becomes a locus for sediment deposition. Sediments from the North American continent were carried across the continental shelf and deposited in these intraslope basins as turbidite deposits, as illustrated in Figure 5. As a geologist, I would expect that in the geologic environment dominated by salt evacuation basins such as the Shen basin, vertical salt movement through salt feeders and subsequent development of a salt canopy would fracture the existing rock volume beneath the salt

[158] *see* Expert Report of Robert Merrill, ¶ 32, Fig. 5.

[159] Expert Report of Robert Merrill, ¶ 31 ("When the salt meets an overlying resistant bed, it spreads laterally, forming the canopy").

canopy. The expected result would be dominated by radial faults away from the salt feeders and possibly some concentric faults caused by salt canopy expansion."

182. **Rebuttal to Merrill ¶ 32:** Although faults are expected in the Shenandoah basin, the intensity and impact of that faulting is an uncertainty that must be assessed with improved seismic, drilled wells, and, eventually, actual production. Merrill states that he "would expect that in the geologic environment dominated by salt evacuation basins such as the Shen basin, vertical salt movement through salt feeders and subsequent development of a salt canopy would fracture the existing rock volume beneath the salt canopy."[160] Although this is a possibility, typical subsalt developments in deepwater Gulf of Mexico have not found this to be the case, or for faults to be an unmanageable problem. The location, intensity, and significance of the faulting in these settings is driven by the relative timing of movement and supply of salt and the relative rate of sediment deposition. The complexity of interplay between these factors is difficult to accurately reconstruct and only appraisal and production serve to provide the information that is needed. This risk is often accounted for by reducing the estimated recovery factor for the field. However, the large number of profitably developed deepwater subsalt fields in the Gulf of Mexico is inconsistent with Merrill's conclusion that sediments in such a setting would suffer extensive "fracturing."

B. Rebuttal to Merrill's "Risk Assessments"

184. **Merrill ¶ 36:** "Geoscientists consider several factors to assess an oil prospect's uncertainty, including the factors below from available geological and geophysical data, and assign each factor a confidence level between 0% and 100%. Peter R. Rose (1992) first considered three elements to describe the chance that a well finds hydrocarbons: reservoir presence, hydrocarbon

[160] *See* Expert Report of Robert Merrill ¶ 32.

charge, and sealed closure. Subsequently, he added two additional parameters: containment and migration. Multiplying the percentages together, assuming independence, results in the probability of geologic success ('Pg'). Pg is an input to the Multi-Method Risk Analysis (MMRA) software developed by Rose & Associates and used by Anadarko for probabilistic resource assessment. After discovery and appraisal wells indicate sufficient oil and gas resources for commercial development, the reservoir characteristics dominate the risk profile. Such factors include:

> (a) Is there an adequate source rock available to generate hydrocarbons, and when were the hydrocarbons generated?
>
> (b) Was a hydrocarbon trap present when hydrocarbons migrated?
>
> (c) Is there a reservoir rock present at the drill site and of sufficient quality to produce hydrocarbons?
>
> (d) Is there a trap present to ensure closure, and how reliable is the map, including data quality?
>
> (e) Traps require containment, top, bottom, and an effective lateral seal. Are these factors present?"

185. **Rebuttal to Merrill ¶ 36:** Merrill confuses elements of a hydrocarbon system that are risked before exploration and after exploration. Elements of "adequate source rock" and timing of "hydrocarbons generated" are already proven by a successful discovery well and no longer are necessary for the risking. Merrill's characteristics of important factors to be assessed "after discovery and appraisal wells indicate sufficient oil and gas resources for commercial development" focus not on the factors he has listed, but on elements that impact the details of the hydrocarbon accumulations extent and elements affecting the field's recovery efficiency.

C. <u>Rebuttal to Merrill "Resource Assessment"</u>

186. **Merrill ¶ 38:** "Industry experience gives ranges of the P10/P90 ratio, which measures geologic uncertainty or risk. The P10/P90 ratio is commonly accepted by companies using the MMRA software as a measure of resource uncertainty. In other words, a prospect in a

producing basin, but a new trend is expected to have a P10-P90 ratio of 45-129. A prospect in an established trend is expected to have a P10-P90 ratio between 10 and 45. The list below is arranged from least certain to most certain, as published by Rose & Associates.

(a) Frontier prospect (no production in the basin) P10/P90 = 120-650

(b) Rank wildcat (producing basin, but a new trend) P10/P90 = 45-120

(c) Prospect in the same trend P10/P90 = 10-45

(d) Close in/Drill Deeper (Nearby production) P10/P90 = 5-10

(e) Development (Established production in the field) P10/P90 = 2-7"

187. **Rebuttal to Merrill ¶ 38:** Although Merrill does not give a citation for these statements, which have been reported by Rose & Associates in presentations, they are not universally accepted in the industry, as Merrill suggests. First, many companies use a variety of methodologies for estimating risked volumes and the Rose & Associates MMRA software is not the only, or even the most common, method used. Second, the Rose & Associates "RoseRA Handbook",[161] which defines the use of the MMRA software, does not indicate these ranges and allows users to either enter P10 and P90 values to estimate P10/P90 ratios or allows users to enter a mean value and a P10/P90 value to calculate P10 and P90 values. It provides no "standards", "guidance" or "warnings" as to these range of values. The P10/P90 values calculated by Anadarko during the exploration and appraisal campaign were not substantially different than the P10/P90 values calculated by the other partners during appraisal. These values are not consistent with Merrill's suggestion that these values should have raised a "red flag" to management as they were inconsistent with industry standards.[162] These values for P10/P90 simply represent the general

[161] RoseRA Quick Start Handbook v1-1-20201112.

[162] Expert Report of Robert Merrill, ¶ 40.

perception of the Anadarko and Partner teams that the risk of those volumes being present was lower than the risk associated with typical exploration wells. **Figure 16**, below summarizes how each partner's P10/P90 ratio was assessed over course of the Shenandoah appraisal:

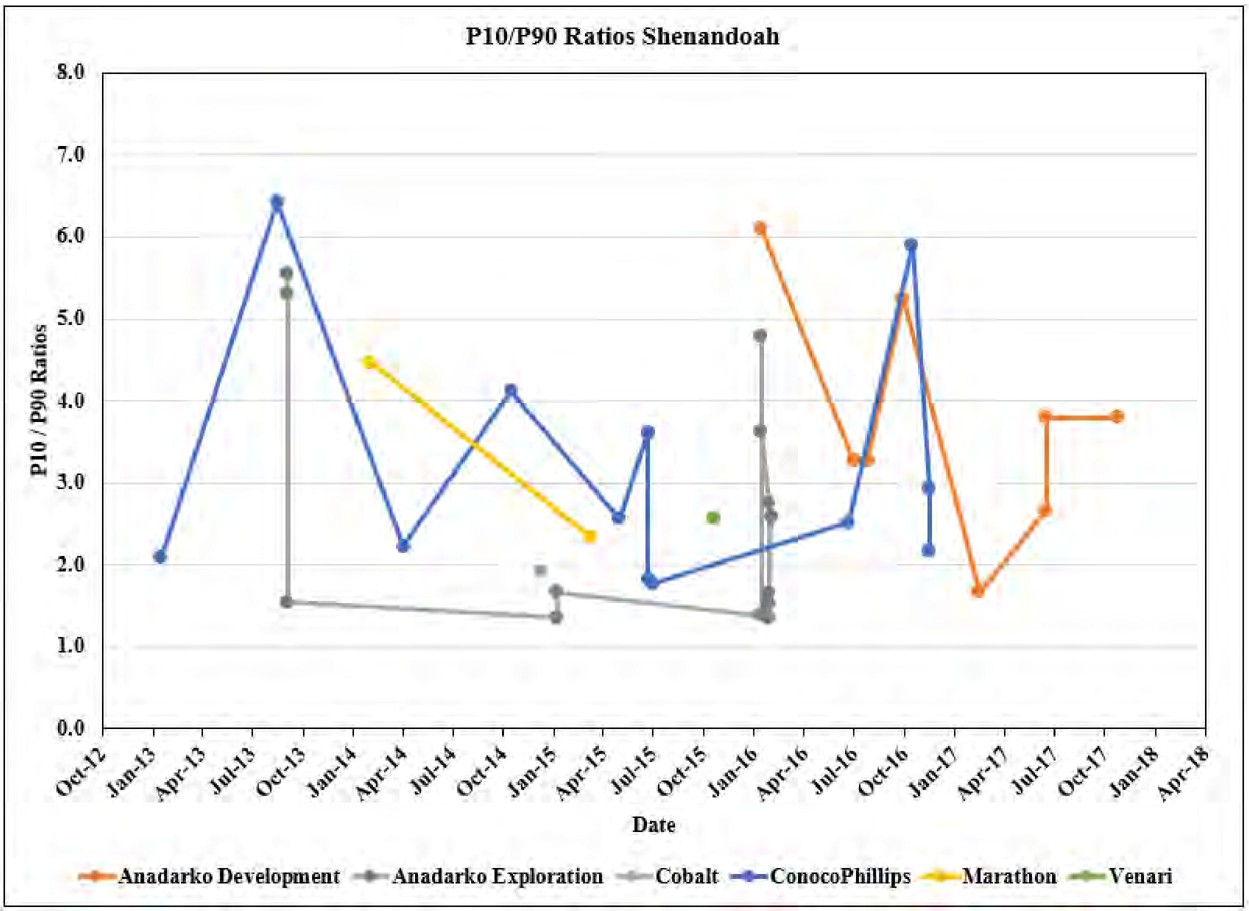


Figure 16 – A historical plot of Shenandoah P10/P90 volume assessment ratios by each partner over the appraisal process. Note fairly close independent assessments in the 2.0-to-6.0 range which is inconsistent with Merrill's assessment that these ranges should have been recognized as "too small."[163]

[163] ANACOP00005640, pp. 58, 62; ANACOP00008900, p. 5; ANACOP00009398, p. 14; ANACOP00009420, pp. 3, 7; ANACOP00014518, p. 49; ANACOP00024675, pp. 97-98; ANACOP00025504, p. 2; APC-00000646, p. 3; APC-00001448, pp. 3, 12; APC-00083873, p. 41; APC-00153588, p. 1; APC-00256036, pp. 34-35; APC-00299898, p. 2; APC-00663564, p. 2; APC-00704016, pp. 12-13; APC-01166304, p. 10, 19; APC-01288761, p. 1; Marathon_000001, p. 102, 109; Marathon_000411, pp. 14-16; Marathon_003170, p. 3; Marathon_003734, p. 70; and Marathon_011477, p. 105 (for sources marked with an asterisk, P values were calculated using reported STOOIPs using a 20% recovery factor).

188. It is clear that Merrill's assessment that the P10/P90 ratios were a "Red Flag" is not shared among the different partners included in the Shenandoah partnership, as their P10/P90 ratios generally moved between the 2.0 to 6.0 range depending upon how appraisal wells addressed existing uncertainties, and how new information raised the new uncertainties.

189. **Merrill ¶ 40:** "Given the uncertainty in the Shen project mapped area and the potential variability of sand thickness in the turbidite fans of the Wilcox as described above, the P10/P90 ratios determined by the resource estimates of the Exploration team were much narrower than industry experience suggests. In 2008, prior to drilling Shen-1, the calculated P10/P90 ratio was 6. From industry experience, the predicted uncertainty for a Trend Wildcat Well, as the exploration team classified this, should have been 10-45. Following the completion of the Shen-2 well, individual Wilcox zones had P10/P90 ratios between 2.8 and 6.0; most were 3.0 or less, typical level of uncertainty for development projects, not appraisal projects. Because the uncertainty in the up-dip areal extent as imaged in the seismic, no well penetrations of the oil-water contact, with only two well penetrations, in my experience, I would expect such an appraisal project to have a P10/P90 ratio between 10 and 45, not 2.8-6.0. It is also apparent that Anadarko's exploration team, using MMRA, did not use the standard check of P1 and P99 for either the input parameters or the resource distribution. If the P1 and P99 were scrutinized, the team should have recognized potential issues with the distributions used in the MMRA."

190. **Rebuttal to Merrill ¶ 40:** Merrill opines that after the Shen-2 appraisal, the P10/P90 ratios should have been "between 10 and 45, not 2.8-6.0."[164] However, as discussed above in Paragraphs 187-188, the P10 and P90 values calculated by Anadarko during the exploration and appraisal campaign were not substantially different than the P10 and P90 values calculated by the

[164] Expert Report of Robert Merrill, ¶ 40.

other partners during appraisal. These partner-determined values are incompatible with Merrill's suggestion that these values should have raised a "red flag" to management, or that they were inconsistent with "industry standards." In my expert opinion, each company estimates volumes and characterizes P10/P90 risked volumetric estimates in a different way that is internally consistent, and does not necessarily conform to any industry average.

191. Merrill also opines that "[i]f the P1 and P99 were scrutinized, the team should have recognized potential issues with the distributions used in the MMRA." This is an invalid assumption on Merrill's part in that P1 and P99 values are not easily judged as they only represent likelihood of occurrences at 1% and at 99%. Merrill has also failed to support his assertion with any reference to the recommended volumetric estimate procedures used within Anadarko or any other Shenandoah partner. Both P1 and P99 estimates are extremely unlikely occurrences for which few people have firsthand experience, and which are not uniformly inspected or scrutinized.

192. It appears that Merrill criticizes the technical competence of the Shenandoah technical teams at Anadarko and supports his opinion with a vague, unsupported reference to what is commonly accepted in the industry. Merrill fails to consider, however, that the estimates generated by Anadarko's subsurface evaluation teams were generally consistent with the other four partners in the Shenandoah appraisal.

D. Rebuttal to Pittinger "The Impact of Faulting"

193. **Pittinger ¶¶ 20, 21:** "Fault planes can be barriers to oil flow, limiting the effective drainage areas of production wells and preventing pressure support between injection wells, aquifers, and production wells. Hence, sealing faults, which act as complete barriers to flow, negatively impact the commercial viability of the field by reducing the recovery efficiency and volume of oil each well can be expected to produce and by increasing the number of production and injection wells required. Paying close attention to compartment boundaries is crucial,

otherwise optimal placement of producers and injectors becomes a haphazard and costly exercise. . . . [F]aulting was a significant risk due to the field's particular environment."

194. **Rebuttal to Pittinger ¶¶ 20, 21:** Pittinger describes some of the possible risks associated with faulting, but neglects to note that these issues only adversely impact the commercial viability of a field if they are so prevalent and so dense that the faulted compartments are too small to support the economic cost of a producing well. Producing wells only drain an effective radius surrounding them and faults located beyond those boundaries have little impact on the field's commerciality. There is no evidence at Shenandoah of that level of dense faulting in the center of the basin away from the salt walls, and there is no evidence at Shenandoah of faults separating the basin center aquifer from the up-dip oil columns.

195. **Pittinger ¶ 22:** "Anadarko Exploration management advocated using a simple unfaulted, laterally continuous structural model, counter to structural models developed by both Anadarko's Shen Pre-Development Team and project partners. This adherence to unrealistic and overly optimistic assumptions by Exploration management and Anadarko's senior management led to public statements exaggerating the likelihood of successful development, resource size, and value."

196. **Rebuttal to Pittinger ¶ 22:** The record shows that Exploration made the conscious choice to not put faults on their maps unless they were technically indicated on seismic with supporting well evidence that was accepted by a consensus of its partners.[165] Exploration included faults on their maps as data became available that met these criteria. Structurally faulted maps from both Anadarko development and partners changed over time, with faults being added and as the

[165] *See, e.g.*, Strickling Dep. Tr. 139:12-17.

appraisal program progressed. Exploration never put a fault on a map that subsequently needed to be removed (as Development and some partners did).

197. Pittinger is mistaken when he claims that Anadarko made "public statements exaggerating the likelihood of successful development, resource size, and value."[166] Based on my review of the Amended Complaint, it is clear that Anadarko never made any public statement that indicated whether Shenandoah would be developed or not, and Anadarko never publicly disclosed the Shenandoah field's specific resource size or value. Pittinger has not cited any evidence to support his claims to the contrary. In fact, he said it was beyond the scope of his report to consider whether resource ranges were used to support Anadarko's public statements about Shenandoah, and that public statements "[i]n general" were outside the scope of his report.[167]

E. Rebuttal to Pittinger "Appraising the Shenandoah Resource"

198. **Pittinger ¶ 167:** "A primary objective of appraising a deep-water discovery is to reduce the uncertainty in the size and quality of the resource so that decisions such as whether to proceed or exit and how to develop the field can be made with a reasonable level of confidence. Appraising a discovery is very much a 'value of information' exercise. The cost of new information, mostly drilling wells, needs to be weighed against the impact on the value derived from that information."

199. **Rebuttal to Pittinger ¶ 167:** Pittinger's statement that "[t]he cost of new information, mostly drilling wells, needs to be weighed against the impact on the value derived from that information" is not entirely correct, as this only defines the "efficiency" at which the appraisal proceeds. In addition, there are other non-technical risks which must be weighed –

[166] Expert Report of Lyndon Pittinger, ¶ 22.

[167] Pittinger Dep. Tr. 20:3-9, 95:10-96:1.

partner opinions, rig availability, 180/360-day clocks for continuous operations, availability of capital, etc.

200. **Pittinger ¶ 168:** "A simplified approach to assessing the value of information is estimating the probability that the new information will affect or change decisions multiplied by the value added by those changes. Risks and uncertainties abound when the reservoir is almost six miles below the surface, reservoir pressures approach 24,000 psig, water is over one mile deep, development wells are expected to cost more than $200-$310 MM to drill and complete, and total capital investment might exceed $10 billion. The quality of the reservoir becomes especially important in a high-cost setting in which wells cost several hundred million dollars."[168]

201. **Rebuttal to Pittinger ¶ 168:** Pittinger's description of "value of information" ("VOI") is technically correct, but these VOI calculations are highly influenced by how the creator chooses to quantify risks and probabilities based on their own personal view of a given project. Additionally, non-technical risks are difficult to appropriately assess, and one may not be willing to "accept" the negative consequences of a particular outcome. Simple VOIs are useful for clarifying the field of options, but they seldom should be used as the principal method for decision making. Pittinger is also correct that reservoir quality is especially important in high-cost appraisal projects. However, he fails to adequately tie that statement back to his earlier one regarding the potential value derived from drilling additional appraisal wells. Indeed, the only way to gain definitive information regarding reservoir quality is to drill new wells.

202. **Pittinger ¶ 170:** "Each parameter is most commonly described using a log-normal probability distribution to quantify the uncertainty in the potential range of outcomes."[169]

[168] Expert Report of Lyndon Pittinger, ¶ 168.

[169] *Id.* ¶170.

203. **Rebuttal to Pittinger ¶ 170:** This is not exactly true. A log-normal distribution is the statistical result of multiplying many different, independent, random, normally distributed (Gaussian) variables together. Some variables in resource-sizing are not "exactly" normally distributed (*e.g.*, volume expansion factor, hydrocarbon saturation, recovery efficiency, etc.), and some variables are not "independent", particularly when dealing with "stacked pays." The result is that relying on this claim solely without intimate understanding of the probabilities can also be influenced by operator biases. In my expert opinion, a combination of probabilistic and deterministic estimation of resource sizes provide the best technical work.

204. **Pittinger ¶¶ 171–173:** "Minimum Commercial Field Size ('MCFS') is a useful concept to help understand the importance of field resource size, especially what percentage of the resource range falls above and below the MCFS. . . . The MCFS can be determined by modeling cash flows of development scenarios of varying resource volumes. The MCFS is the field size with breakeven economics: smaller sizes have negative discounted net present values, with larger sizes providing positive values due to the economy of scale. Typically, the MCFS is calculated for different oil prices, because the price can be the significant uncertainty driving value. . . . When well costs are high and lateral continuity uncertain, estimated ultimate recovery per well ('EUR/well') can also be an important uncertainty impacting the MCFS. The EUR/well is primarily impacted by net pay per completion, effective drainage area per well, and recovery efficiency. Both effective drainage area per well and recovery efficiency are adversely impacted by reservoir compartmentalization caused by faulting and stratigraphic changes."

205. **Rebuttal to Pittinger ¶¶ 171–173:** Development commerciality can be influenced by a host of other factors, such as adding services and hub capabilities that others must pay to access and lowering the economic hurdles for other potential developments in the area. These were

all "in play" with a potential Shenandoah development. Development commerciality goes well beyond simply technical calculation based upon recoverable resource. Notably, though, despite describing MCFS as "a useful concept to help understand the importance of field resource size," Pittinger does little through the remainder of his report to engage with the MCFS calculations, relying almost entirely on the PIR10 figures.

206. **Pittinger ¶¶ 174–175:** "PIR10 is an important concept for understanding Shen's commerciality. PIR10 stands for Profit to Investment Ratio discounted at 10%. The term is widely used in the petroleum industry as an economic measure of capital efficiency. The numerator is the net present value of estimated cash flows discounted at 10% and the denominator is the net capital invested, also discounted at 10%. The measure is useful for ranking the capital performance of a portfolio of investment opportunities. A threshold PIR10 represents the minimum value required for an investment to be approved to receive capital funding in the budgeting process. In Mr. Hollek's deposition on 9/8/22, he testified that Anadarko's threshold PIR10 was 0.30. . . . PIR10 at .3 was thus an important metric for determining whether Shen was economically viable by Anadarko's own standards and practice. This meant that if the PIR10 dropped below .3, Shen would not likely receive funding."

207. **Rebuttal to Pittinger ¶¶ 174–175:** Pittinger's description of this economic concept is correct, but his description as to how it is used is not. While Anadarko uses 10% for the discount rate of all its referenced calculations, not every company assumes the same discount factor, and most companies would do the calculation at a range of discounts, including at zero discount. Also, PIRs are calculated at different times for different reasons. During the exploration phase, the value of PIR is used to prioritize opportunities to invest in, leases to buy, and potential fields to pursue. During appraisal, PIRs are used as a measure of sensitivity to uncertainties.

Estimating PIRs of P10s, P50s, an P90s during appraisal can help determine the key uncertainties that are influencing capital investment, optimum commerciality, and upside potential, and these can be used to decide how to proceed in the appraisal program. The appraisal can then target those uncertainties that will help decide if a field is commercial, and, if it is, how to extract the most value from it.

208. Pittinger claims that "[a] threshold PIR10 represents the minimum value required for an investment to be approved to receive capital funding in the budgeting process." This is not true. There is no support for the contention that a project must meet a certain "threshold" to continual appraisal. Moreover, the PIR10 is not the only criteria a company considers. One must consider non-technical risks, downside risk, and exposure to the upside in making a decision to continue in appraisal investment. This investment must be balanced across a corporate portfolio to keep the company robust in view of future uncertainties in opportunities and commodity prices. Continued appraisal funding would depend on other factors as well since the company must also take into account its available capital and the relative strength of other projects that are competing for that capital.

209. Pittinger's assessment of Anadarko's "standards and practice" is incorrect. In support, Pittinger references Mr. Hollek's deposition, stating that "on 9/8/22, [Hollek] testified that Anadarko's threshold PIR10 was 0.30." However, this is a distortion of Mr. Hollek's testimony. Mr. Hollek also indicated that a PIR10 of 0.3 was "a general guideline."[170] He did not testify that it must be met at every stage of the appraisal process or that a project could not be sanctioned if it did not reach a PIR10 of 0.3. It also is not clear from Mr. Hollek's testimony that 0.3 is the only metric that Anadarko used in making its decision. As Mr. Camden attested, "[T]here

[170] Hollek Dep. Tr. 53:18-19.

was no policy requiring that a project receive a PIR of a 0.3 to continue appraisal or to be sanctioned, and a 0.3 hurdle rate was not a strict guideline for investment."[171] Mr. Camden attested that the appraisal team would "would not consider a PIR rate less than 0.3 to signify that the appraisal should cease or the project should not proceed further."[172] Mr. Camden himself verified that he worked on projects that "under some conditions and assumptions" had a PIR of less than 0.3 during the appraisal stage—and were ultimately sanctioned.[173]

210. Even at FID, a PIR10 of 0.3 for the P50 case would not be the only criteria, and a company would want to know what the PIR10 would be for both the low (~P90) case and the high (~P10) case and would want to weigh all of the non-technical risks and uncertainties. Mr. Camden attested that "it was generally understood that projects should deliver 30%, or greater, more profit than the sum of investments over the life a project."[174] But even then, a PIR10 at or above 0.3 was an important value but not the only criteria to be considered.[175]

[171] Camden Declaration ¶ 7.

[172] *Id.*

[173] *Id.*

[174] *Id.*

[175] *Id.* ¶ 8.

VI. THE SHENANDOAH APPRAISAL PROJECT

A. Pre-Shen-1

211. As of 2006, Anadarko controlled approximately half of the Shenandoah prospect through its lease of Walker Ridge Block 52 ("WR 52"), which it obtained through its acquisition of Kerr-McGee in 2006. In 2007, Anadarko partnered with Cobalt International Energy ("Cobalt") in a bid to lease Walker Ridge Block 51 ("WR 51"), but was outbid by ConocoPhillips. The most up-dip part of the prospect was interpreted to be on the northern OCS Block WR8 held by Exxon and Nexen and set to expire in June 2008. Anadarko suggested forming a 3-block exploration partnership unit (WR8, WR51, and WR52), in 2008, but Nexen declined. Anadarko later sold part of its interest in WR51 to Cobalt, leaving interests in the remaining 2-block unit (WR51 and WR52) at ConocoPhillips (50%), Anadarko (30%), and Cobalt (20%). ConocoPhillips then sold part of their interests in the unitized 2-blocks, setting interests at the time of drilling Shen-1 at: ConocoPhillips at 40%, Anadarko at 30%, Cobalt at 20%, and Marathon at 10%, and with Marathon paying a disproportionate share of ConocoPhillips' costs.[176]

212. Mapping on the Shenandoah prospect began in June 2007 with maps created by Anadarko Exploration staff who interpreted Veritas seismic data.[177] These maps were used to engage potential partners and subsequently, to bid at the October 2007 Federal Lease Sale.[178]

[176] APC-01669695 at slide 4.

[177] APC-01166304.

[178] *Id.*

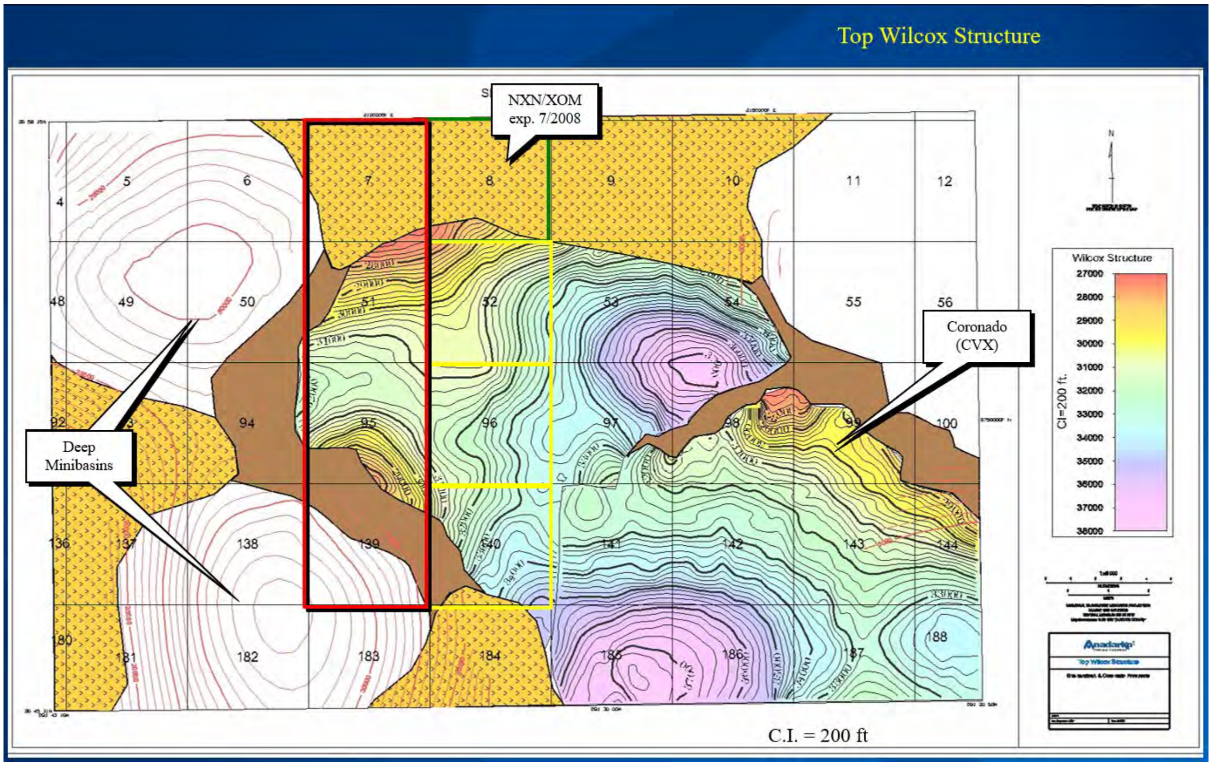


Figure 17 – 2007 Anadarko Exploration Map in June 2007 for Shenandoah Prospect showing interpreted un-faulted structure and open blocks available in the upcoming Federal Lease Sale.[179]

213. After the Lease Sale was complete and partnerships were agreed, each partner shared similar maps with small variations in the interpreted up-dip limits of the reservoir, but without any interpreted faulting. This remained the most up-to-date map until the drilling of Shen-1.

[179] APC-01669692 at slide 10.

CONFIDENTIAL

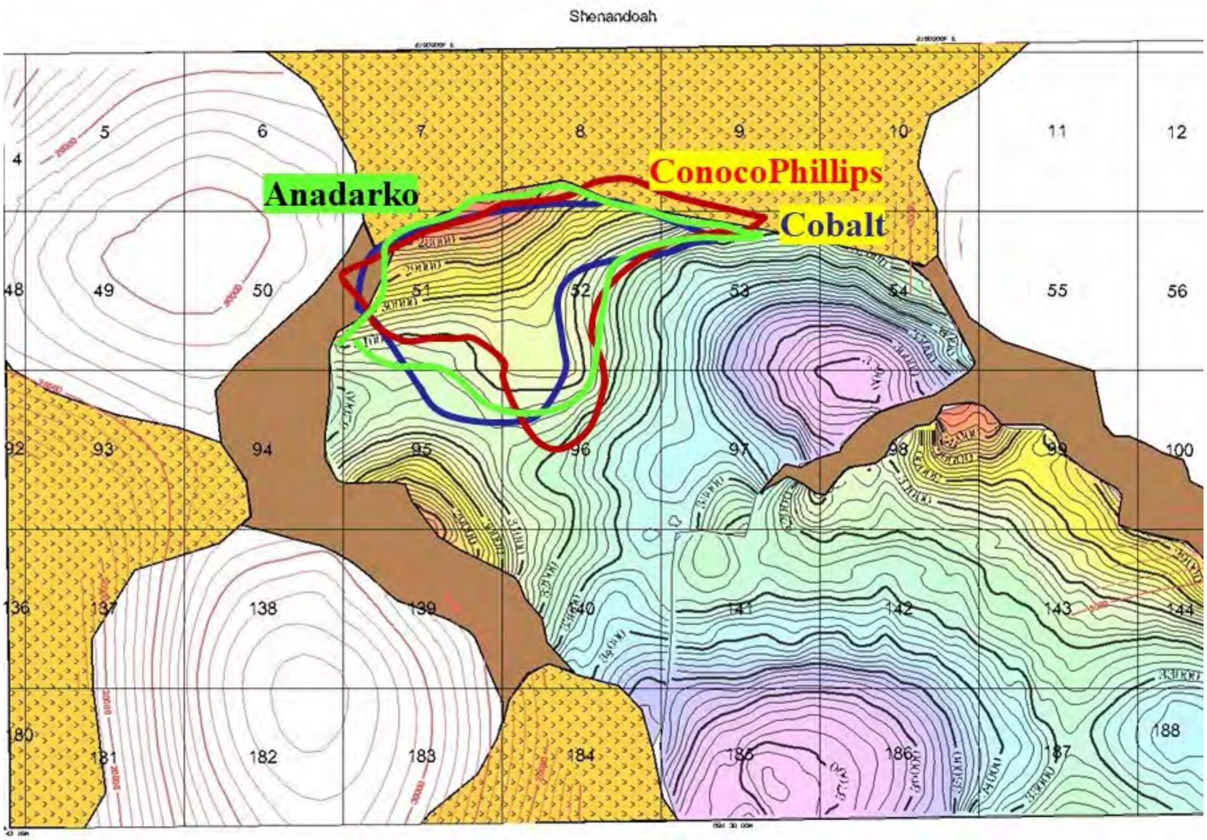


Figure 18 - Anadarko map of Shenandoah with comparison of partner trap outlines[180]

B. Shen-1

1. Well Results

214. Anadarko spud its first discovery well in the Shenandoah area in WR 51 on June 3, 2008, referred to as Shen-1 or WR 51-1. Anadarko finished drilling Shen-1 and a bypass well on January 22, 2009.[181]

215. Shen-1 discovered approximately 300 feet of oil-bearing sands in the Lower Wilcox interval. The well logs and by-pass core from Shen-1 allowed for evaluation of rock and fluid

[180] Outlines of Anadarko, Cobalt, and ConocoPhillips interpretations supplied by Dr. R. Detomo, Jr., based on APC-01669692; APC-01737814; APC-01737817).

[181] APC-00001146 at slide 4.

properties, which were better than had been expected based on other similar discoveries in the Lower Tertiary play. Anadarko announced their discovery in February 2009.[182]

216. Prior to spudding that well, Anadarko's internal mean estimate for the Shenandoah prospect was 110 million barrels of oil equivalent ("MMBOE"). After Shen-1, Anadarko updated their internal net risked resource estimates for Shenandoah to 280 MMBO.[183]

2. Structure Mapping

217. After the successful drilling of the Shen-1 well, much effort went into trying to understand the nature of the discovery and of the apparent OWCs seen in the Lower Wilcox "A" and "C" oil sands and in predicting how far downdip one should test to look for the OWC for the "D" and "E" oil sands. At this point, neither Anadarko nor their partners interpreted any faulting impacting the discovery (see **Figure 19** below).[184] The Shen-2 appraisal well was designed to test the estimated OWC for the "E" sand that was estimated from pressures and trap sealing capacity.

---

[182] APC-01335462.

[183] APC-00593836.

[184] APC-01740518 at slide 13.

CONFIDENTIAL

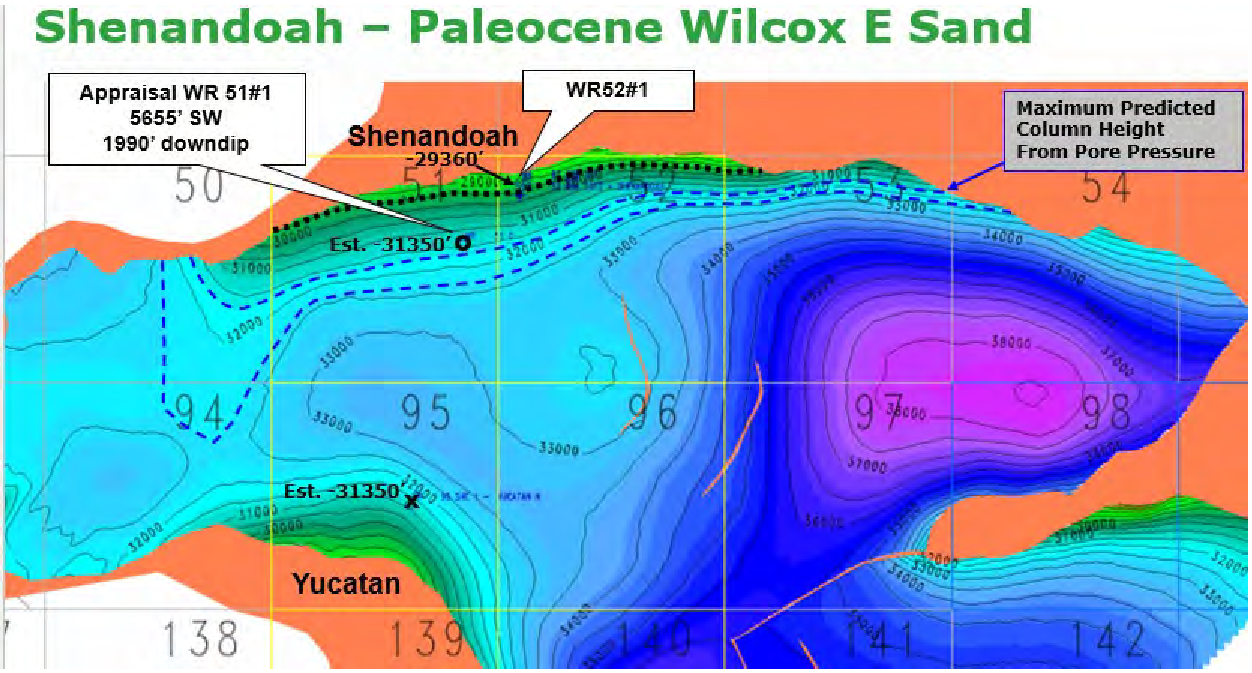


Figure 19 - Anadarko Exploration's final map prior to drilling Shen-2. No faulting of the discovery is yet interpreted or expected by partnership, and continuity from Shen-1 to Shen-2 is projected for all reservoir sands. OWCs for the "E" sand is estimated from trap sealing capacity.[185]

3. <u>Alleged Misstatements</u>[186]

a. *Amended Complaint ¶ 30 Shenandoah "reservoir properties" that appeared to be "of much higher quality than industry has seen previously in the emerging Lower Tertiary play"*

218. Vice President of International and Deepwater Exploration Bob Daniels described the Shenandoah Discovery well as having "reservoir properties" that "appear[ed] to be of much higher quality than industry has seen previously in the emerging Lower Tertiary play."[187] "Reservoir quality" generally refers to the size, porosity, and permeability of the reservoir. The American Association of Petroleum Geologists states that the "quality of the reservoir" is "defined by its hydrocarbon storage capacity and deliverability. The hydrocarbon storage capacity is

[185] APC-01740518 slide #13.

[186] I assess both the pre-Class Period statement, which I understand to be allegedly inflationary statements, and the Class Period alleged misstatements. I refer to them both as "misstatements" for ease of reference.

[187] Dkt. 55 - Amended Complaint; ¶ 30, p. 10.

characterized by the effective porosity and the size of the reservoir, whereas the deliverability is a function of the permeability. Effective porosity is the volume percentage of interconnected pores in a rock."[188]

219. Before to the Shenandoah Discovery, the "Lower Tertiary play" in the Gulf of Mexico deep-water had focused on the Wilcox-aged turbidites that had been discovered and were planned to be developed at Jack, St Malo, Cascade, Chinook, and Stones. Reservoir properties, including porosity and permeability, can represent a continuum of values based upon their thermal and burial history, but typically degrade in rocks that are older, are hotter, and are buried deeper. The reservoir properties of the Wilcox-aged turbidites discovered prior to Shen-1 had not been as favorable as those encountered in the Gulf of Mexico discoveries in younger (Miocene) and shallower reservoirs. However, Shen-1 reservoir properties were much better than had been seen in the previously discovered Lower Tertiary plays identified above.[189]

---

[188] AAPG Wiki – *quality of the reservoir*.

[189] APC-01740527 at slide 14.

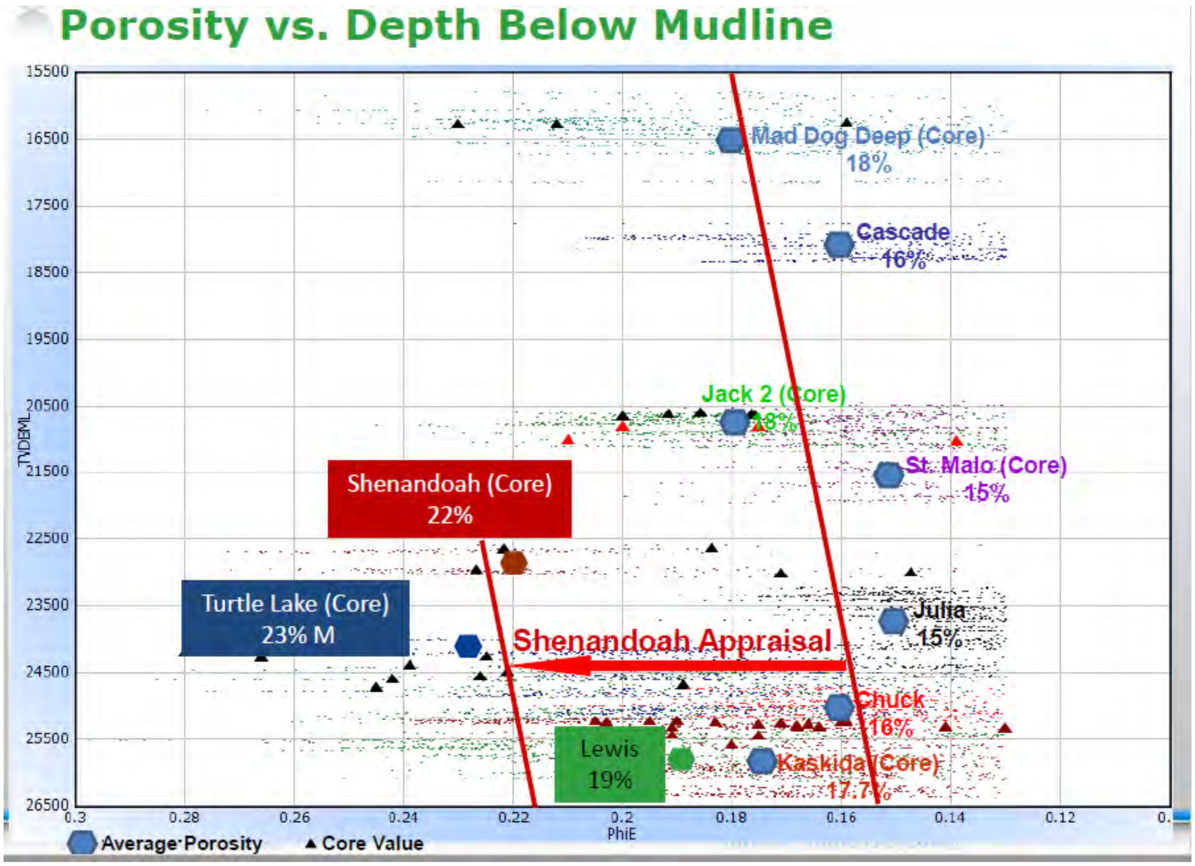


Figure 20 - A comparison of Shenandoah measured porosities versus other Lower Tertiary Wilcox discoveries demonstrating the significantly better reservoir encountered at Shen-1.[190]

220. Mr. Daniels referred to the reservoir properties at Shen-1 as compared to those that were expected and that had been encountered in other "Lower Tertiary play" discoveries. Prior to the Shen-1 Discovery, Anadarko expected porosities at Shenandoah in the ~16-24% range, better than the Industry average,[191] and encountered porosity at the high end of their expectations in the ~23-24% range.[192]

[190] APC-01740527 at slide 13.

[191] APC-01669692 at slide 21.

[192] APC-01740527 at slide 11.

CONFIDENTIAL

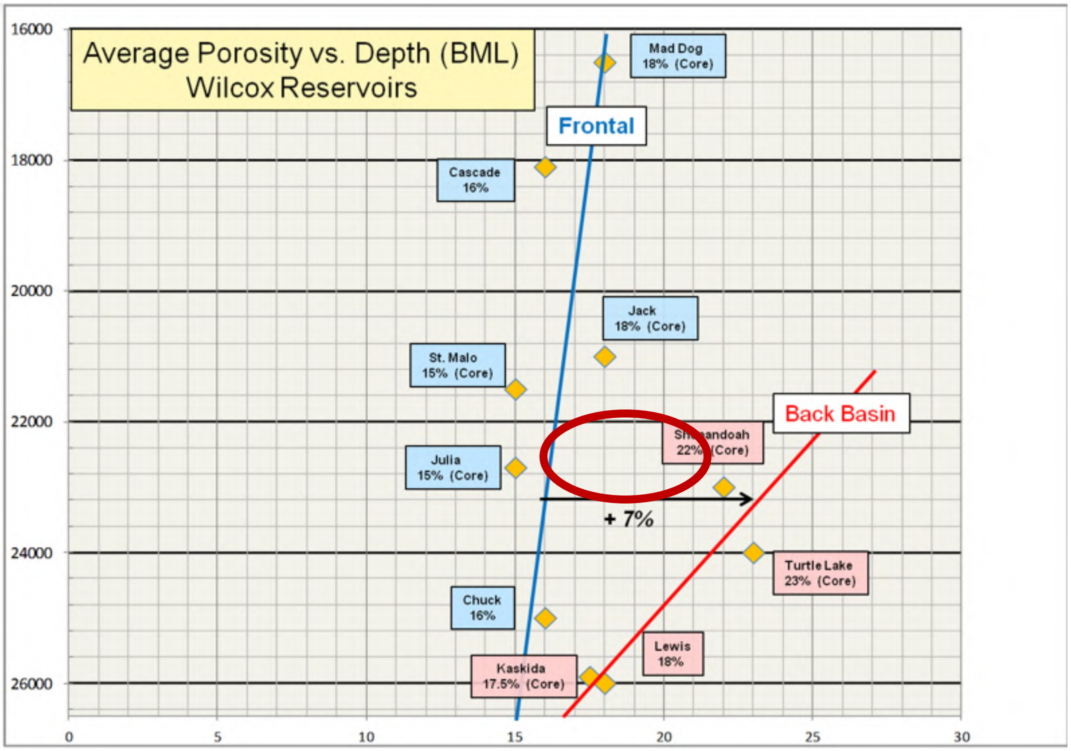


Figure 21 - Graph showing the improved porosity versus depth relationship expected at Shenandoah due to its "back-basin" location.[193]

221. Similarly, Industry averages of reservoir permeabilities in the previous Wilcox discoveries had been in the ~ 10-100mD range,[194] but the Shen-1 had permeabilities in the ~250-300mD range.[195] This improved permeability will have a positive impact on the recovery factor expected for the Shenandoah reservoirs. Thus, the Shenandoah reservoir properties were determined to be much better than in the previously discovered Lower Tertiary reservoirs.

[193] APC-00129805 at slide 24 (oval illustration added by Dr. R. Detomo, Jr.).

[194] APC-00129805 at slide 25.

[195] APC-01740527 at slide 11.

CONFIDENTIAL

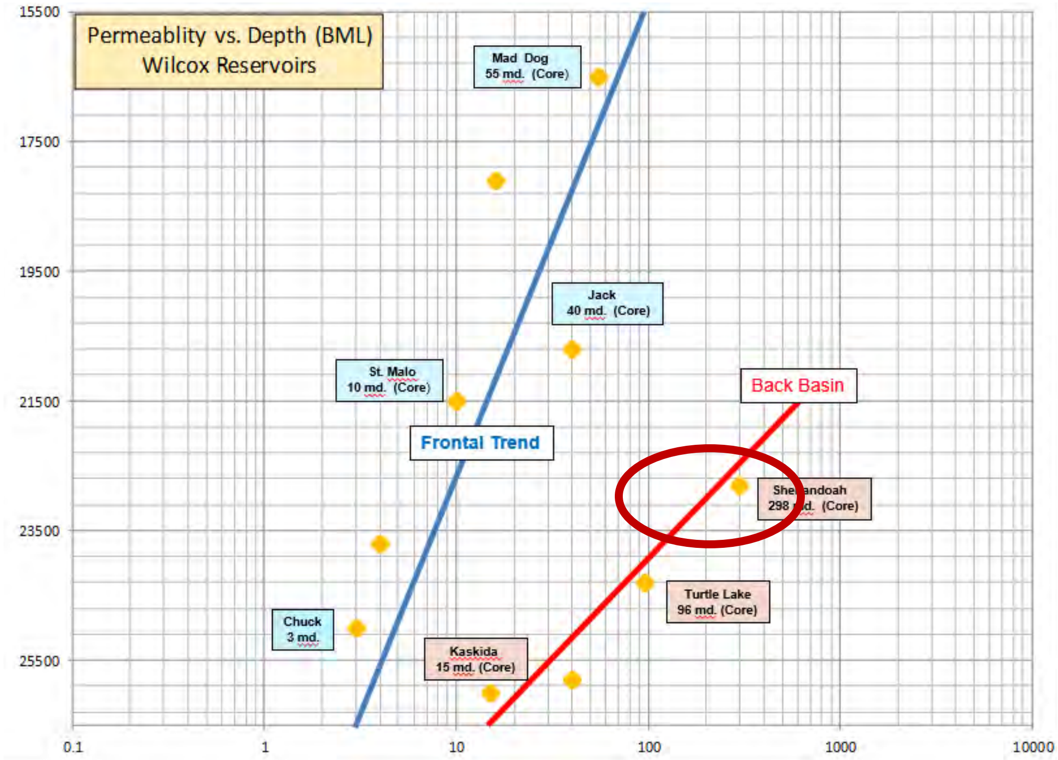


Figure 22 - Graph showing the improved permeability of Shenandoah and other "back-basin" opportunities.[196]

222. The Shen-1 well encountered ~300 feet of oil and over 630 feet of net reservoir sand of "excellent quality" that was comparable to later Shenandoah appraisal wells and with reservoir porosities of 23-24% as determined by the well logs and agreed with by partners.[197] The Shen-1 discovery was described by partners as "Best in play."[198] The reservoir quality of the Shenandoah wells is among the best for any Gulf of Mexico Paleogene Lower Wilcox discovery.[199] This was demonstrated by a comparison of Shen-1's reservoir properties and other Wilcox reservoirs discovered in the Gulf of Mexico, as shown in **Table 1**, below:

[196] APC-00129805 at slide 25 (oval illustration added by Dr. R. Detomo, Jr.).

[197] APC-00001085 at slide 6 & ANACOP00000137 p. 11.

[198] ANACOP00008087 at slide 34.

[199] APC-00704016 at slide 11; APC-00002151 at slides 11-12.

Wilcox Well Comparison						
	Jack	St Malo	Cascade	Chinook	Stones	Shen 1
Avg Porosity (PHIE)	0.18	0.16	0.1	0.18	0.17	**0.23**
Avg Permeability	32	17	30	66	30	**250-300**

Table 1 – Comparison of reservoir porosity and permeability of Wilcox discoveries.[200]

223. Although there was some degradation of the permeability downdip in the subsequent Shen-3 appraisal well[201] observing a decrease in the permeability in the downdip wet leg of a deep-water turbidite is not unusual and chemical processes associated with the water commonly act to reduce the reservoir properties. Even so, the measured reservoir quality of the Shenandoah reservoirs is excellent compared to other Gulf of Mexico Paleogene discoveries.[202]

b. *Amended Complaint ¶ 31 Exploration target of over 800 million MMBOE*

224. In March 2012, Anadarko publicized its target goal of delivering "over 800" million barrels of oil equivalents ("MMBOE") across its entire worldwide portfolio.[203] Plaintiffs allege that this inflated the public's impression of Shenandoah, as "Shenandoah alone constituted approximately one-third of the projected resources to meet that goal, which at that time would have made it the third largest resource ever found in the Gulf of Mexico."[204] This was a review of Anadarko's planned worldwide Exploration target for 2012.[205] Accompanying this statement was

[200] APC-00002305 at slide 71.

[201] Marathon_014736 at slides -12-13.

[202] APC-00704016 slide 11.

[203] Dkt. 55 - Amended Complaint, ¶ 31.

[204] *Id.*

[205] 2012.03.12 - Investor Conference Transcript p. 37.

CONFIDENTIAL

a slide indicating that the "800+" Exploration target related to "net risked resources" from across the globe, spanning over 50 wells.[206]

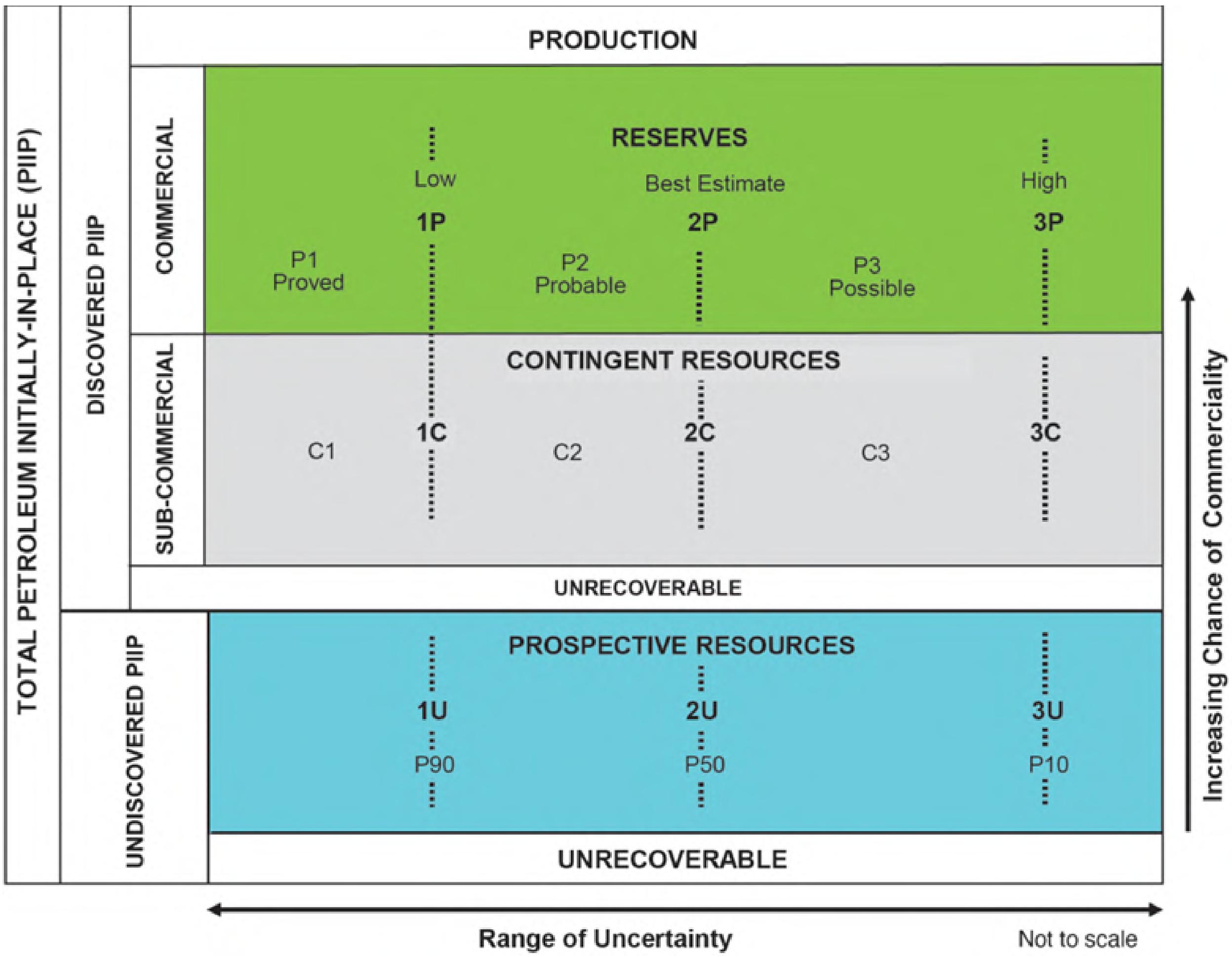


Figure 23 – Society of Petroleum Engineers chart defining ranges of uncertainty for reserves, contingent resources and prospective resources, respectively.[207]

225. Exploration goals are based upon making discoveries and delivering these discovered volumes to the company's portfolio. "*Delivering over 800MMBOE*" of Exploration volumes refers to Exploration having discovered Proved, Probable, and Possible Reserves that

[206] 2012.03.13 - Investor Conference Presentation at slide 98.

[207] Petroleum Resources Management System, June 2018 (v.1.03), Society of Petroleum Engineers.

total 800 MMBOE equivalents (~6000 cu. ft. gas = 1 BBOE).[208] "Net risked" resources represent a "risk weighted value" that is derived from averaging each probabilistic volume outcome weighted by its estimated likelihood of occurrence, and then multiplied by Anadarko's net interest in the venture. The presentation does not clearly indicate if these references are likely being made to "net risked in-place" volumes or "net risked recoverable" volumes.

226. The statement of "2012 targeted Exploration net risked volumes of ~800MMBOE" references the targeting of "new" or "additional Exploration volumes" and not Exploration volumes already discovered. Exploration Resource Exposure Volume records indicate that this target is composed of both international (Mozambique & Brazil) and Gulf of Mexico deepwater prospects (Phobos, Shenandoah, and Coronado).[209] Since the Shenandoah discovery was in the appraisal phase, only the additional net risked volumes anticipated from Shen-2 were included in this Exploration target.

227. This Exploration volume target is spread over several deepwater wells to be drilled globally and what fraction of the 800 MMBOE that might be assigned to Shenandoah is not specified in Anadarko's public presentations. However, Anadarko resource tracking records[210] indicate that the majority (> 750 MMBO) of the resource volume being targeted is being derived from Mozambique, and less than 100 MMBO is being targeted from Shenandoah. Plaintiffs' claim that "a third of these ~800 MMBOE volumes" are attributable to Shenandoah" is *not* found in

[208] APC-00001289 Anadarko Reserves Manual p. 5-1.

[209] APC-01672140.

[210] *Id.*; APC-01204634.

either the Investor Conference Transcript[211] or the Investor Conference Presentation,[212] nor is it supported from the Anadarko Exploration documents.

228. Anadarko's P90/P50/P10 volume estimates at the Shenandoah field were assessed as 80/145/220 MMBO[213] before Shen-2 and 952/1197/1469 MMBO[214] post Shen-2. Using the three points of Anadarko's probability distribution (P90-P50-P10), the estimated "net risked added volumes" would be the average of:

90% Probability: 30% x 90% x (952-80) = 235 MMBO

50% Probability: 30% x 50% x (1197-145) = 158 MMBO

10% Probability: 30% x 10% x (1469-220) = 38 MMBO

229. The average of these volume estimates is 144 MMBO, which is less than 20% of Exploration's 2012 net risked volumes target of ~800 MMBOE . Additionally, this amount would need to be reduced by the discovered volume ascribed to the Shen-1 discovery well (~41 MMBO)[215] leaving an estimate of ~103 MMBO as contributing to the "targeted Exploration net risked volumes", or approximately 13%, much less than the claimed "1/3."

4. Rebuttal to Pittinger Opinions re: Shen-1

230. **Pittinger ¶ 25:** "The Shen-1 discovery well, drilled in 2009, encountered a reported 300 ft. of oil pay, and pressures from MDT surveys indicated pressure *compartmentalization*

[211] 2012.03.12 - Investor Conference Transcript.

[212] 2012.03.13 - Investor Conference Presentation.

[213] APC-01166304.

[214] APC-00585873.

[215] APC-01204634.

vertically in the well. The oil samples from each zone varied in measured density and gas content, supporting a degree of vertical *compartmentalization*."[216]

231. **Rebuttal to Pittinger ¶ 25:** Pittinger incorrectly characterizes the sands as having vertical "compartmentalization" instead of being vertically separated. Wilcox "A" and "C" sands' OWC was penetrated, and Wilcox "D" and "E" sands were oil to base of sand in the well. In fact, pressure measurements at Shen-1 "A" and "C" sands in the water are consistent with each other (and other water pressure measurements in the Shenandoah basin), and all wet sands "look[] to generally be on the same fluid gradient."[217] Therefore, there is no evidence from Shen-1 that these sands are vertically isolated from each other. In addition, the Shen-1 "D" and "E" sands have pressures measured in the oil column only and any difference in pressure measured here indicates a non-vertically connected oil accumulation that may simply be the result of different oil column heights in each sand, as they may well be connected to the same common aquifer downdip.

232. **Pittinger ¶ 176:** "The well was eventually reported to have 236 feet of net pay TVT, which is substantially less than initially claimed."[218]

233. **Rebuttal to Pittinger ¶ 176:** Determination of "net feet of pay" is subject to chosen petrophysical cutoffs which can change by petrophysical interpreter and change based upon additional data from other wells over time. The early petrophysical estimates were over 300 feet of net pay TVT.[219] Each of the documents to which Pittinger cites, all of which are internal documents, show that there were approximately 300 net feet of pay.

---

[216] Expert Report of Lyndon Pittinger, ¶ 25 (emphasis added).

[217] APC-01288068 at slide 20.

[218] Expert Report of Lyndon Pittinger, ¶176.

[219] APC-00594667 at slide 7 (showing "311' Net Pay" from Shenandoah Prospect Summary Dec. 17, 2013).

C. Shen-2

1. Well Results

234. Following the results of Shen-1, Anadarko initiated an enhanced seismic imaging project that took place from July 2009 to September 2010[220], the goal of which was to better understand the subsurface structure. The partnership was expanded in 2012 to include Anadarko at 30% ConocoPhillips at 30%, Cobalt at 20%, Venari at 10%, and Marathon at 10% working interests.[221] Following a drilling moratorium in the Gulf of Mexico from May to October 2010 due to the Deepwater Horizon explosion, the Shenandoah partners resumed the appraisal project and agreed upon the location for Shen-2 within WR 51.[222] However regulatory filings, approvals of authorizations for expenditure ("AFEs") for the well, and drilling rig delays resulted in the Shen-2 appraisal well—also referred to as "WR 51-2"—not being spud until July 1, 2012.

235. Shen-2 reached its target depth on January 29, 2013 and encountered 1,001 feet of oil in a series of eight Wilcox sands (specifically, the Upper Wilcox 1, 2 and 3 sands, and the Lower Wilcox A through E sands).[223] The reservoir and hydrocarbon qualities in Shen-2 were likewise better than previous Lower Tertiary plays in the Gulf of Mexico,[224] and every Shenandoah partner significantly increased their estimates of recoverable volumes from the field.[225]

236. The significance of the Shen-2 well in relation to other Lower Tertiary prospects discovered to that point is difficult to overstate. As depicted below in **Table 2**, Shen-2 found a

[220] APC-00001146 at slide 4.

[221] ANACOP00003083 Operating Agreement Third Amendment.

[222] APC-01740527 at slide 3.

[223] APC-01314375 at slide 34.

[224] APC-00002305 at slide 71.

[225] *See* Marathon_000411; APC-01166304; ANACOP00009398.

thicker oil column and better porosity, a much higher GOR, and improved oil viscosity readings than any comparable well that had been drilled in the Lower Tertiary, and had better-than-average permeability readings. Taken together, these values indicated that one could expect higher oil flow rates from Shenandoah wells, and improved ability for oil to easily move from the reservoir to the producing wellbores.

Discovery Field	**Column Height**	**Porosity %**	**Permeability mD**	**Oil GOR**	**Oil Viscosity**
Shen-2	1001	21%	50	1261	0.89
Cascade	331	10%	30	175	6.42
Chinook	283	18%	66	200	5.99
Jack	831	18%	32	250	3.14
St Malo	344	16%	17	198	2.42
Stones		17%	30	250	

Table 2 – Comparison of Shen-2 well properties with other industry Wilcox discoveries.[226]

[226] APC-00002305 at slide 71.

CONFIDENTIAL

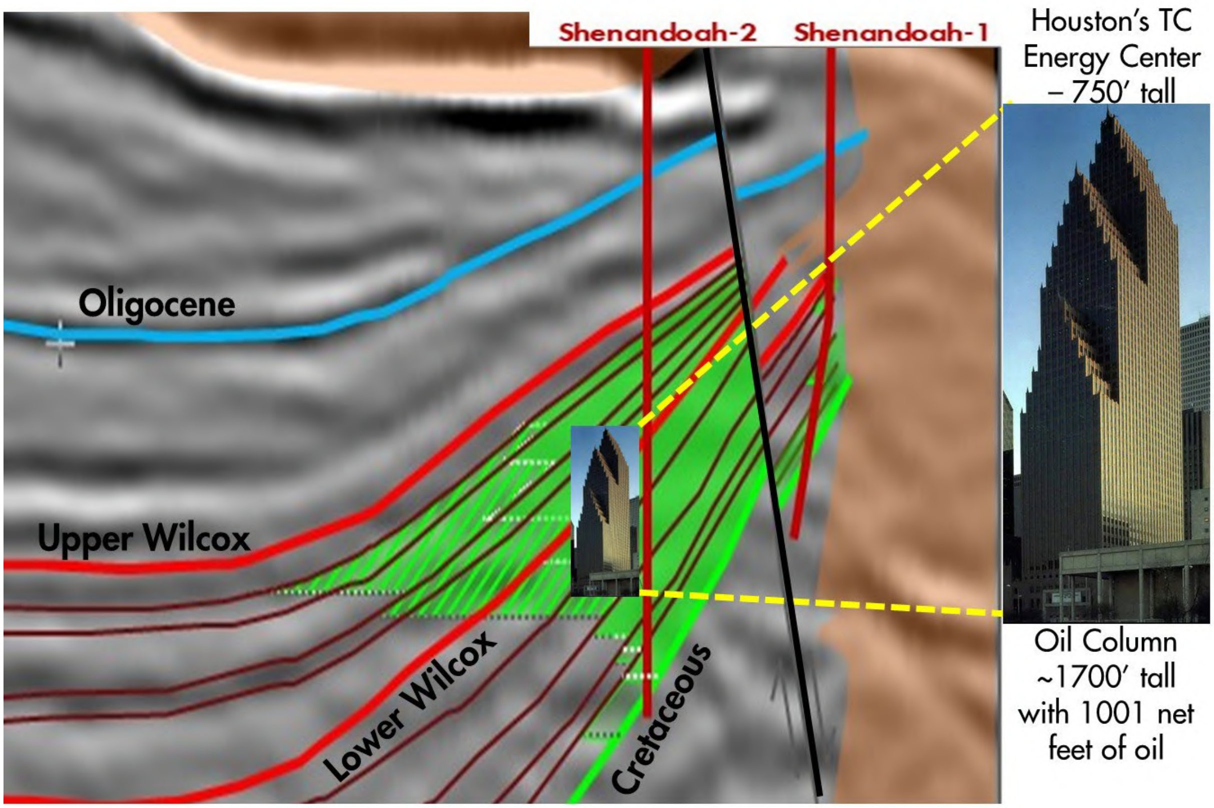


Figure 24 – Cross section showing the Shen-1 and Shen-2 wells and the extremely encouraging ~1,000 net feet of oil in Upper and Lower Wilcox sands penetrated by the Shen-2 well. The total gross oil column was ~1700 feet tall – over twice as tall as Houston's TC Energy Center Tower.

237. In-place and recoverable volume estimates also varied within the partnership at this time, with Anadarko calculating a mean resource estimate of 1,197 MMBOE,[227] ConocoPhillips calculating a mean estimate of 753 MMBOE,[228] and Marathon calculating a mean estimate of 508 MMBOE.[229]

238. At this point, the Shenandoah partnership began major efforts to develop and obtain regulatory approval for production technology that could withstand the 20,000-psi pressure

227 APC-00585873 at -873.

228 ANACOP00009398 at slide 14.

229 Marathon_000001 at slides 102, 109 (MMstb converted to MMBOE using calculated Marathon ratio of 1 MMstb = 1.144 MMBOE).

environment at Shenandoah, since at the time production equipment had only been certified for 15,000 psi environments. In April 2013, Anadarko also brought additional surface and subsurface evaluation staff onto the project to refine and update its development planning and volumetric estimates.[230]

2. Structure Mapping

239. After drilling the Shen-2 well and the discovery of thick upper and lower Wilcox oil sands, the partnership agreed that the Shen-1 and Shen-2 wells were most likely separated by a fault. "Three primary technical data points lend to the interpretation of a laterally extensive fault separating these two wells. 1.) Wet reservoirs in the structurally higher discovery well, 2.) Pore pressure gradients in each correlative lower Wilcox sand is ~ 275 psi higher in the downdip appraisal. 3.) Very steeply dipping beds in the up-dip appraisal well and significantly more low angle dips in the down-dip discover."[231] At this point, Anadarko Exploration and each of their partners began mapping an extensive east-west fault between the two wells separating them at all levels of the sedimentary section.[232] The map created by the Exploration team prior to drilling Shen-3 is depicted in **Figure 25** below, showing the east-west fault separating Shen-1 and Shen-2:

[230] APC-00573912.

[231] APC-00001020.

[232] APC-00577352.

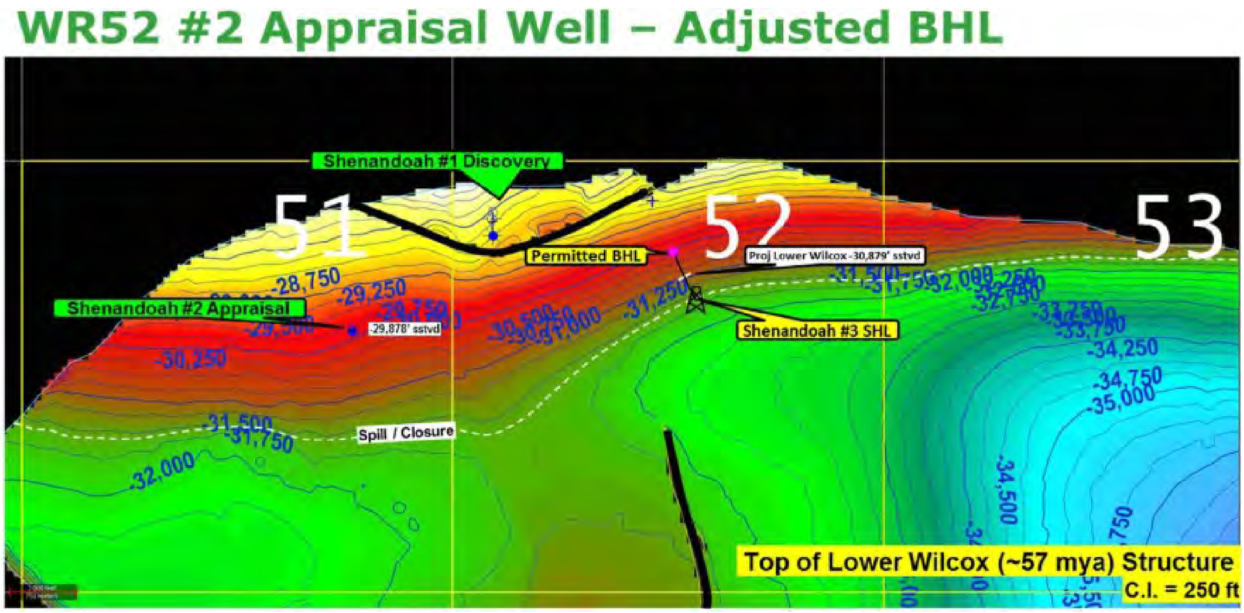


Figure 25 – Anadarko Exploration map used for planning the Shen-3 appraisal well. This map shows the generally accepted east-west fault separating the Shen-1 discovery well from Shen-2.[233]

240. Although the Shenandoah partners agreed[234] on an east-west fault separating Shen-1 and Shen-2, differing opinions emerged as to the possibility of north-south faulting south of the Shen-1 fault block. During the time between the completion of Shen-2 and the spud of Shen-3, ConocoPhillips[235] and Venari[236] began to suspect that north-south faulting in the oil reservoir may be present. The availability of new seismic data at this time (the WesternGeco "Coil" seismic dataset described above) led ConocoPhillips to map at least four significant north-south faults in the sediments south of the oil reservoirs. (*See* **Figure 26** below).[237] However, prior to drilling the

233 APC-00135061 at slide 4.

234 *See, e.g*, APC-00135061 at slide #4; APC-01671424 (Cobalt); APC-00584359 (Venari); APC-00584245 (ConocoPhillips); and Marathon_001698 at slide #25 (Marathon).

235 APC-00584245 at slide 2.

236 APC-01229585 at slide 1.

237 APC-00584359 at slide 1.

Shen-3 appraisal well, Anadarko Exploration,[238] Marathon,[239] and Cobalt[240] continued to map the Shenandoah reservoirs as un-faulted between the Shen-2 and the targeted Shen-3 well locations.[241]

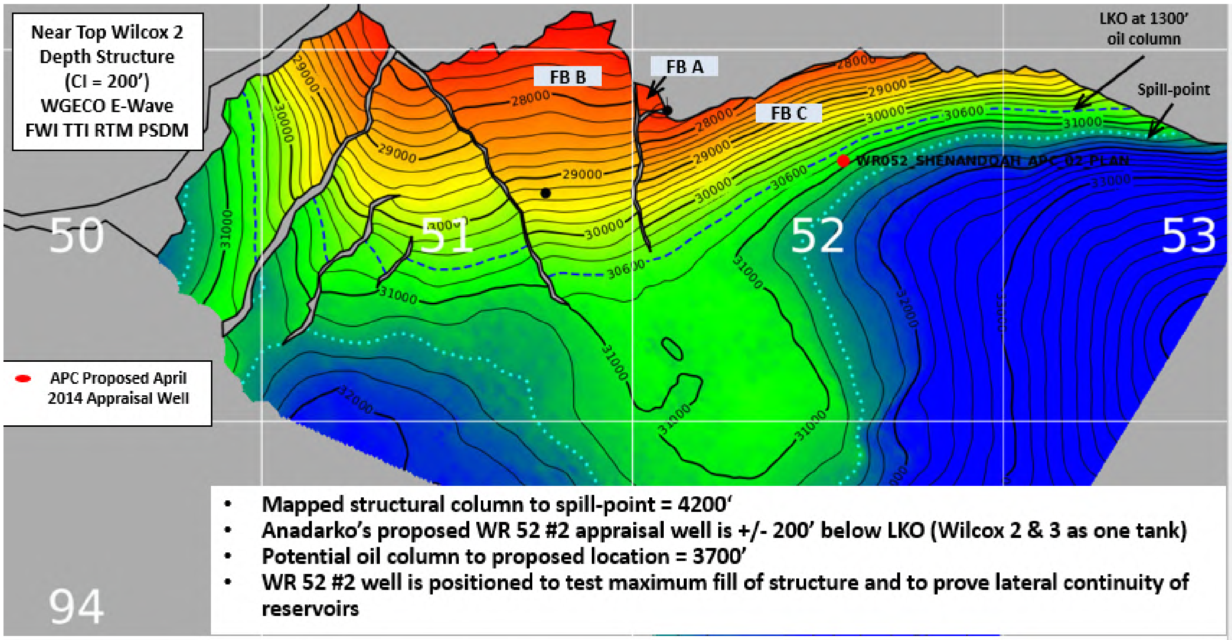


Figure 26 – Venari mapping pre-Shen-3 appraisal well drilling. Venari interpreted a fault between the Shen-2 and planned Shen-3 locations, but also interpreted that fault as only extending as far south as the Shen-2 oil column is proven to fill.[242]

[238] APC-00000907 at slide 7.

[239] APC-00584341 at p. 1.

[240] APC-01671424 at slide 2.

[241] APC-00000907 at slide 7; Marathon_002602 pp. 24-25.

[242] APC-01229585 at slide 1.

CONFIDENTIAL

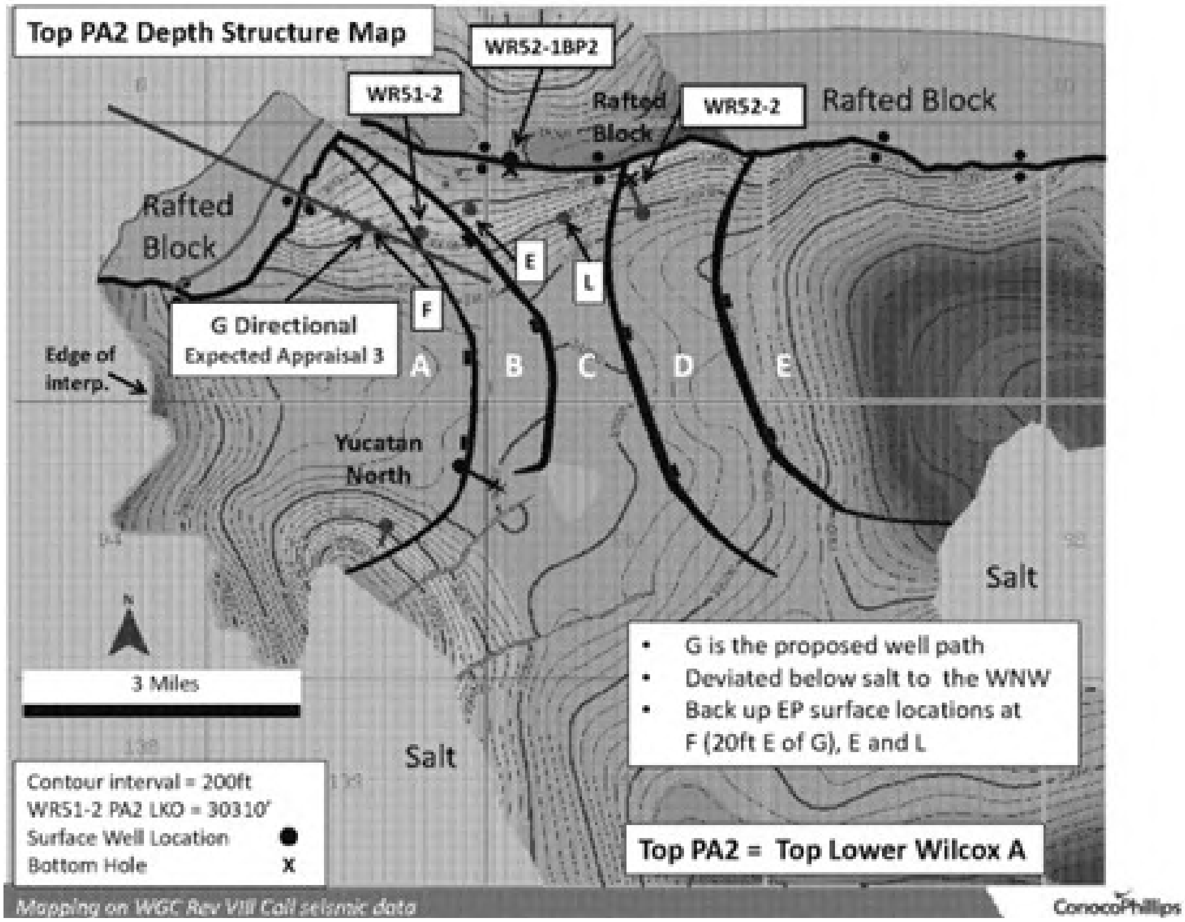


Figure 27 – ConocoPhillips map of Shenandoah using structural dip attributes from the recently available "Coil" seismic data showing four potentially significant north-south interpreted faults.[243]

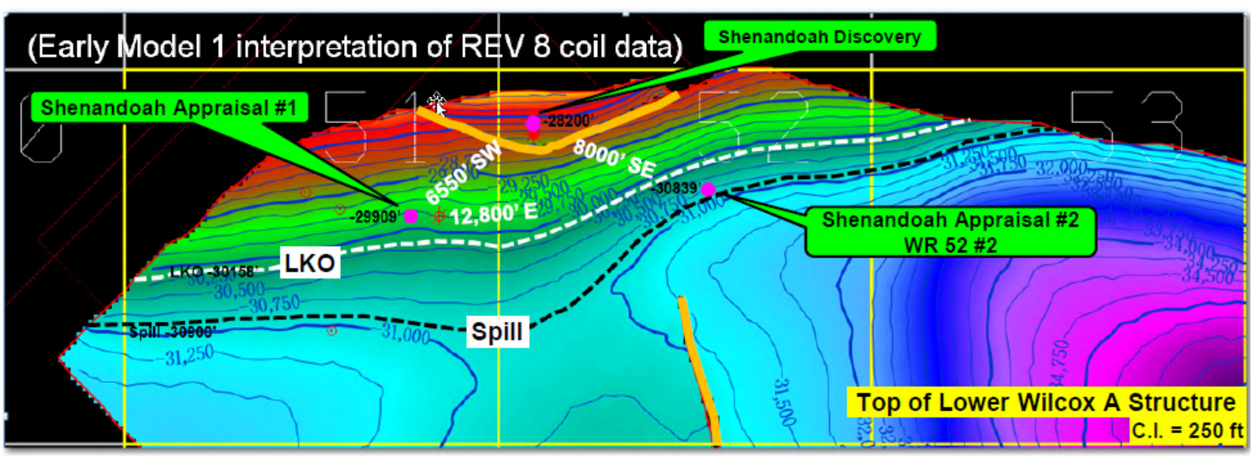


Figure 28 – Anadarko Exploration pre-drill Shen-3 mapping with no faulting interpreted between Shen-2 and the planned Shen-3 location. The Shen-3 planned location is based upon being below

243 ANACOP00006293 at slide 6.

Lowest Known Oil in Shen-2, and above the mapped reservoir spill depth, while testing the reservoir continuity to the east.[244]

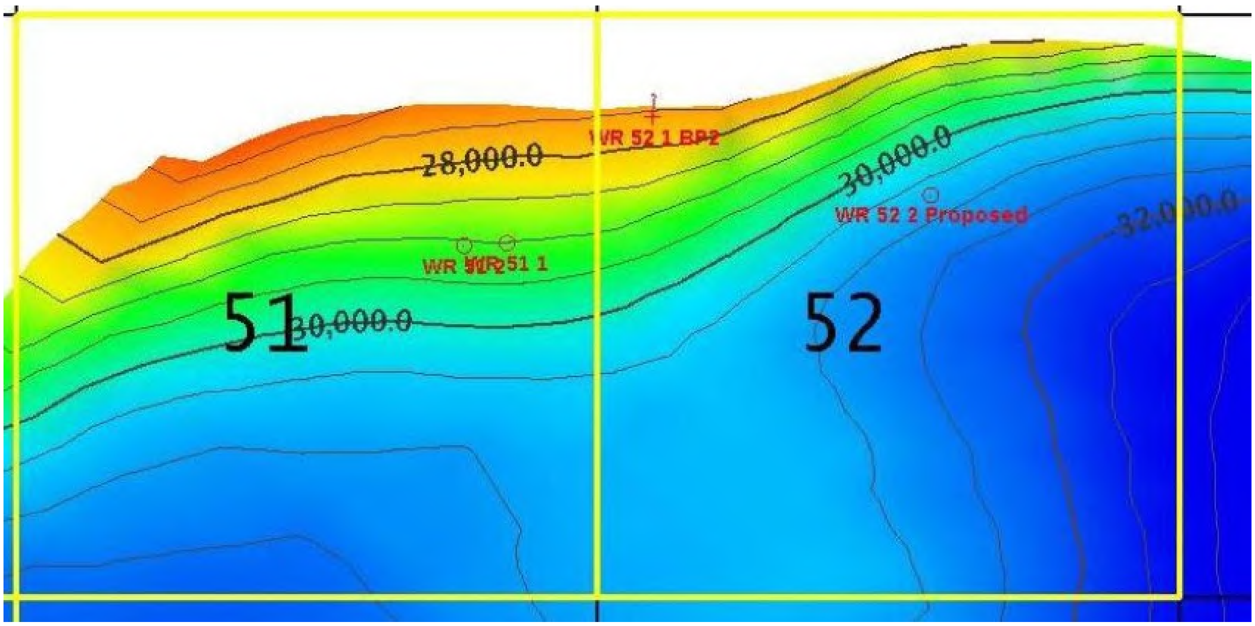


Figure 29 – Marathon map pre-drill for Shen-3 showing proposed appraisal location and no interpreted faults between there and Shen-2.[245]

[244] APC-00000907 at slide 7.

[245] APC-00584341 at slide 1.

CONFIDENTIAL

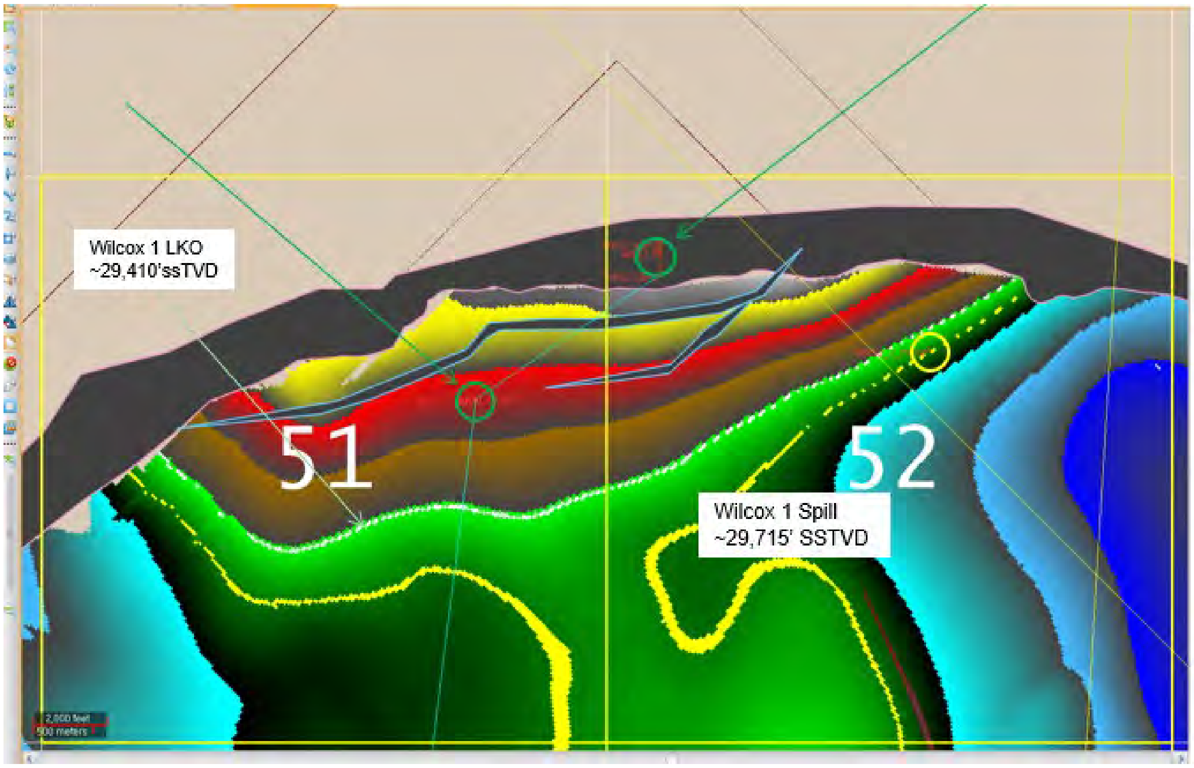


Figure 30 – Cobalt mapping pre-Shen-3 appraisal well (eastern circle). Cobalt has mapped faulting up-dip of Shen-2 (western circle) that separates it from Shen-1 (northern circle). However, no north-south faulting separating Shen-2 from Shen-3 is interpreted, and the Shen-3 appraisal location is targeting a location close to the mapped lowest possible trapped oil.[246]

241. Prior to the spud of Shen-3, Anadarko's Development team had also accessed the new seismic dataset and, following a similar methodology as ConocoPhillips, made an interpretation using structural dip-maps that resulted in a significant number of potential faults[247] and which was different than the Exploration mapping that Shen-3 was planned on and spud upon.[248]

[246] APC-01671424 at slide 2.

[247] APC-00147987 at slide 6.

[248] Marathon_014652 at slide 4.

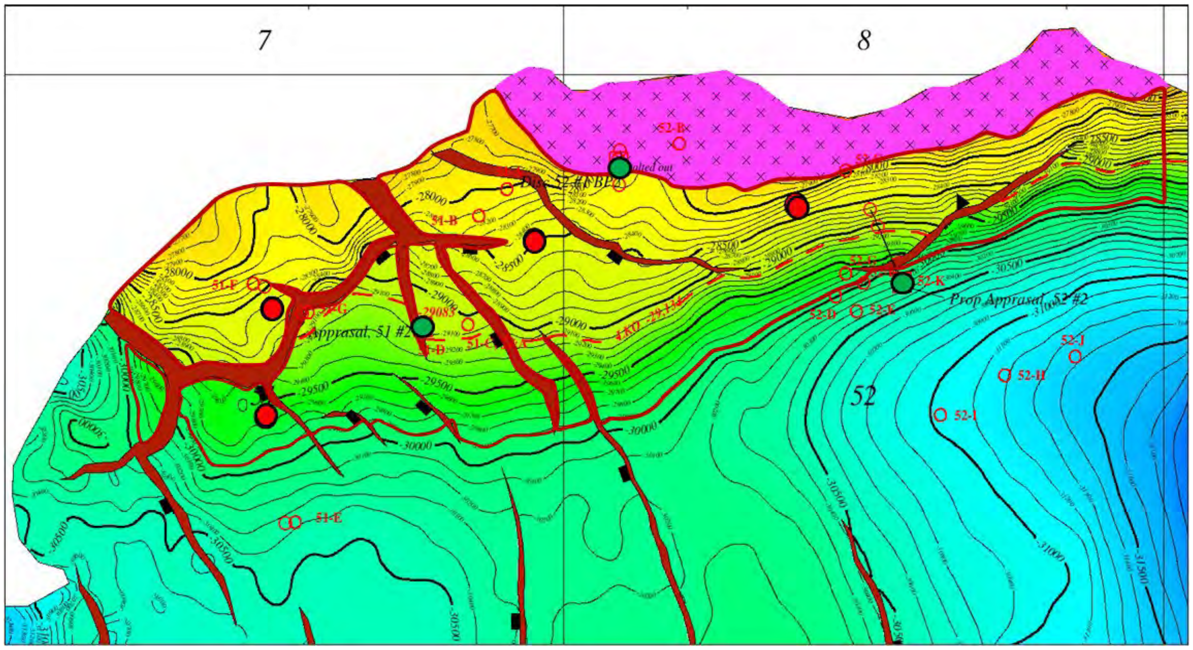


Figure 31 – Anadarko's Development Team mapping from before Shen-3 was completed, interpreting potential faulting and raising the possibility that Shen-2 may not be in a common fault block with Shen-3.[249]

242. The lack of a consensus of the extent or location of north-south faulting in the basin by the Shenandoah partners, and the lack of information of the sealing capacity of any potential fault, left the Anadarko Exploration team with the understanding that faulting may be present, but that it could not be accurately represented on a map. In these cases, it is common to account for undetermined but potential compartmentalization by adjusting the field's estimated recovery factor downward.

243. In recognition of the potential risk of faulting and compartmentalization, Anadarko modeled the potential impact of compartmentalization. For instance, on two separate occasions in August 2014, Doug Shotts provided updates on subsurface modeling to the partnership.[250] These presentations included a reservoir simulation to demonstrate the potential impact of various faults,

---

[249] APC-00147987 at slide 6.

[250] APC-00137267; APC-00001974.

particularly if those faults were sealing. Based on certain economic assumptions and base well constraints, Mr. Shotts examined the following sensitivities: depth trend, commingling, aquifer size and permeability, injection, "[b]arriers – faulting/compartments," the eastern fault block, producer drawdown & BHP constraints, and development timing.[251] Included in both presentations was a set of slides on "artificial barriers," which showed the potential impact of artificial faulting. Through the simulation, these barriers could be switched on or off depending on the scenario to be examined.[252] Mr. Shotts concluded as follows:

- "Highly connected model provides a simplistic and optimistic estimate of recovery/production
- Faulting changes
    - o Main fault added with no transmissibility to divide model into East/West blocks – used in all sensitivities
    - o 'Engineering' barriers added to examine potential finer scale faulting
    - o Formal structural changes to be added as G&G finalize interpretations
- NS faults can still allow for good recovery in compartments that have a producer – either swept from injection or aquifer influx
- EW faults that limit communication with aquifer and/or injectors are highly detrimental to recovery
- The more compartments, the more wells we will need
- Pre-production placement of wells will be very risky if high levels of faulting exist."[253]

244. Mr. Shotts modeled reservoirs across the Shenandoah field with sealing north-south faults located every one mile (denser than the well spacing) and sealing east-west faults also located every one mile (eliminating any possible pressure support). Mr. Shotts's "base case" recovery was calculated at 26%, and the 5% recovery was a P1 worst-case scenario. Mr. Shotts

[251] APC-00137267 at slide 18.

[252] APC-00137267 at slides 43-48.

[253] APC-00137267 at slide 48.

described these faults in his testimony as "not based on physical mapping" and "arbitrary in the sense that [they were] just a grid."[254]

245. The same presentation noted that future work included:

- "Add geologic variability, when available, to probabilistic model
- Implement well and reservoir degradation for production scenarios that drop below AOP estimates
- Incorporate wellbore , flowline networks and early flow assurance constraints
  - Evaluate Completions Scenarios
  - Further evaluation of EOR options
- Incorporate uptime as estimates become available."[255]

3. Alleged Misstatements

a. *Amended Complaint ¶ 32: "The successful Shenandoah-2 well marks one of Anadarko's largest oil discoveries in the Gulf of Mexico"*

246. Anadarko announced the results of Shen-2 in March 2013. In a March 19, 2013, press release, Mr. Daniels is quoted as saying, "The successful Shenandoah-2 well marks one of Anadarko's largest oil discoveries in the Gulf of Mexico, with more than 1,000 net feet of oil pay and reservoir rock and fluid properties of much higher quality than previously encountered by industry in Lower Tertiary discoveries."[256]

247. Exploration discovery wells accurately measure certain information about the thickness of the hydrocarbon column that they penetrate via logging-while-drilling (LWD), but often leave large remaining uncertainties about the lateral extent of the reservoirs in which they

[254] Shotts Dep. Tr. 147:2-5

[255] APC-00137267 at slide 87.

[256] Dkt. 55 - Amended Complaint, ¶ 32.

are drilled. The areal extent of a reservoir is often dependent on trap and spill-point mapping determined from interpretation of seismic data.

248. Without appraisal or production information to validate the hydrocarbons' areal extent, oil discoveries are typically initially characterized simply by the height of the oil column that they encounter. Therefore, Mr. Daniels's reference to Shen-2 as "one of Anadarko's largest oil discoveries in the Gulf of Mexico" is referencing the oil column that was found in the Shen-2 well when compared to other oil columns previously discovered by Anadarko in the Gulf of Mexico.

249. All of Anadarko's previous discovery wells encountered hydrocarbon zones that were less than 1,000 feet in thickness, and often less than 300 feet thick. In the preceding decade, Anadarko announced Gulf of Mexico discoveries with net oil pays of:

Anadarko Well Name	Year Discovered	Net Feel Oil Encountered
K2 North No. 1	2003	128
Dawson Deep*	2004	160
Ticonderoga*	2004	250
East Breaks 599*	2005	135
Genghis Khan	2005	110
Mission Deep	2006	250
West Tonga	2007	350
Heidelberg	2009	200
Shenandoah-1	2009	300
Samurai	2009	120
Vito	2009	250
Lucius	2009	200
Shenandoah-2	2013	1001

Table 3 – Anadarko's Previous Net Feet of Oil encountered in Gulf of Mexico Discoveries compared to Shen-2. Shen-2 was significantly larger than previous Anadarko oil columns.[257]

[257] APC-00153668; "Anadarko Makes Discovery in Gulf of Mexico," Houston Business Journal, November 17, 2003, https://www.bizjournals.com/houston/stories/2003/11/17/daily7.html; "Deepwater GoM Discoveries Thinning," Offshore, January 1, 2005, https://www.offshore-mag.com/regional-reports/article/16762950/deepwater-gom-discoveries-thinning; "Anadarko Makes Deepwater Discovery with Genghis Khan Well,"

250. Each of these discovery wells encountered less net feet of oil pay than what was discovered at Shen-2, which found an oil column of over 1,000 feet. Based upon oil column height, then, the Shen-2 well was accurately characterized as "one of Anadarko's largest oil discoveries in the Gulf of Mexico."

251. It is also important to note the Shen-2's column height was the largest yet encountered in the Lower Wilcox play in the Gulf of Mexico by any oil and gas exploration and production company. In 2008, Anadarko's RCT Team summarized net pay statistics for analogous Lower Tertiary discoveries and found that the average net oil pay per Lower Tertiary discovery well to be 379 feet.[258] Their dataset included:

Rigzone, April 27, 2005, https://www.rigzone.com/news/oil_gas/a/22105/anadarko_makes_deepwater_discovery_with_genghis_khan_well/; "Kerr-McGee Capitalizes on Deepwater Hub With Satellite Discovery," Rigzone, July 1, 2005, https://www.rigzone.com/news/oil_gas/a/23562/kerrmcgee_capitalizes_on_deepwater_hub_with_satellite_discovery/; "Anadarko Makes Deepwater Gulf Find at Mission Deep," Oil & Gas Journal, December 11, 2006, https://www.ogj.com/exploration-development/article/17281208/anadarko-makes-deepwater-gulf-find-at-mission-deep; "Anadarko Announces Gulf of Mexico Discovery," Anadarko Press Release, December 4, 2007; "Anadarko: 'Substantial' Deepwater Discovery in Green Canyon," NGI, February 3. 2009, https://www.naturalgasintel.com/anadarko-substantial-deepwater-discovery-in-green-canyon/; "Anadarko Announces Another Deepwater Gulf of Mexico Discovery," Anadarko Press Release, February 4, 2009; "Anadarko, Partners Report Discovery at Samurai Prospect in GOM," NGI, June 25, 2009, https://www.naturalgasintel.com/anadarko-partners-report-discovery-at-samurai-prospect-in-gom/; "Anadarko Announces Its Fourth Deepwater Gulf of Mexico Discovery in 2009," EuroPetrole, August 2, 2009, https://www.euro-petrole.com/anadarko-announces-its-fourth-deepwater-gulf-of-mexico-discovery-in-2009-n-i-3497; and "Anadarko's Lucius Taps Pliocene, Miocene Oil," Oil & Gas Journal, December 10, 2009, https://www.ogj.com/general-interest/companies/article/17277071/anadarkos-lucius-taps-pliocene-miocene-oil.

[258] APC-00221988 at -990 (also noting that excluding Das Bump as an anomaly, the average is still only 413 feet).

Well Names – Lower Tertiary Discoveries	Net Feet of Oil Encountered
Jack I	480
St. Malo	601
Chinook	283
Cascade	364
Kaskida	631
Jack II	831
Tucker	250
Dana Point	226
Das Bump	36
Stones	215
Mad Dog	250
Shenandoah #2	1001

Table 4 – Summary of Net feet of Oil encountered in Lower Tertiary Gulf of Mexico Discoveries compared to Shen-2.[259] Shen-2 was significantly larger than previously announced analogous oil columns.

252. Thus, compared to nearly any previous oil column height experience in the Gulf of Mexico, the Shen-2 well represented "one of the largest" encountered.

253. In terms of "column height", the Shen-2 well defined a discovery larger than any of Anadarko's previous Gulf of Mexico discoveries. In addition, the reservoir and oil properties encountered in the Shen-1 and Shen-2 wells were better than those seen by competitors in their analogous Lower Wilcox Gulf of Mexico discoveries,[260] leading the Anadarko Exploration team to expect higher recovery efficiencies at Shenandoah that would result in the Shenandoah discovery being one of Anadarko's largest in the Gulf of Mexico.

b. *Amended Complaint ¶ 32: Shen-2 had "reservoir and fluid properties of much higher quality than previously encountered by*

[259] APC-00221988 at -990.

[260] APC-00257632 at -765.

industry in Lower Tertiary discoveries"

254. Plaintiffs challenge Anadarko's March 19, 2013, press release, which quoted Mr. Daniels as saying: "The successful Shenandoah-2 well marks one of Anadarko's largest oil discoveries in the Gulf of Mexico, with more than 1,000 net feet of oil pay and reservoir rock and fluid properties of much higher quality than previously encountered by industry in Lower Tertiary."[261]

255. "Reservoir quality" generally refers to the size, porosity, and permeability of the reservoir. The American Association of Petroleum Geologists states that the "quality of a reservoir" is "defined by its hydrocarbon storage capacity and deliverability. The hydrocarbon storage capacity is characterized by the effective porosity and the size of the reservoir, whereas the deliverability is a function of the permeability. Effective porosity is the volume percentage of interconnected pores in a rock."[262]

256. "Fluid quality" generally refers to the properties of both the oil, and of the water that it is in contact with. The "quality of the fluid" is determined by: (i) the ease with which it can move through the pores of the reservoir (viscosity, mobility); (ii) the amount and type of impurities that are contained within it (CO2, sulfur, heavy metals, etc.); (iii) the amount of gas saturated within it (GOR); and (iv) the distribution of the different length hydrocarbon molecular chains that it is composed of (API). Fluids that are "lighter" (high API & high GOR) typically have high mobility and are less viscous allowing for higher well production rates and higher recovery

[261] Dkt. 55 - Amended Complaint, ¶ 32.

[262] AAPG Wiki, *Reservoir Quality*.

efficiencies. Oils which are "sweet" have very low contaminants, which reduce the cost of refining and demand a higher price.[263]

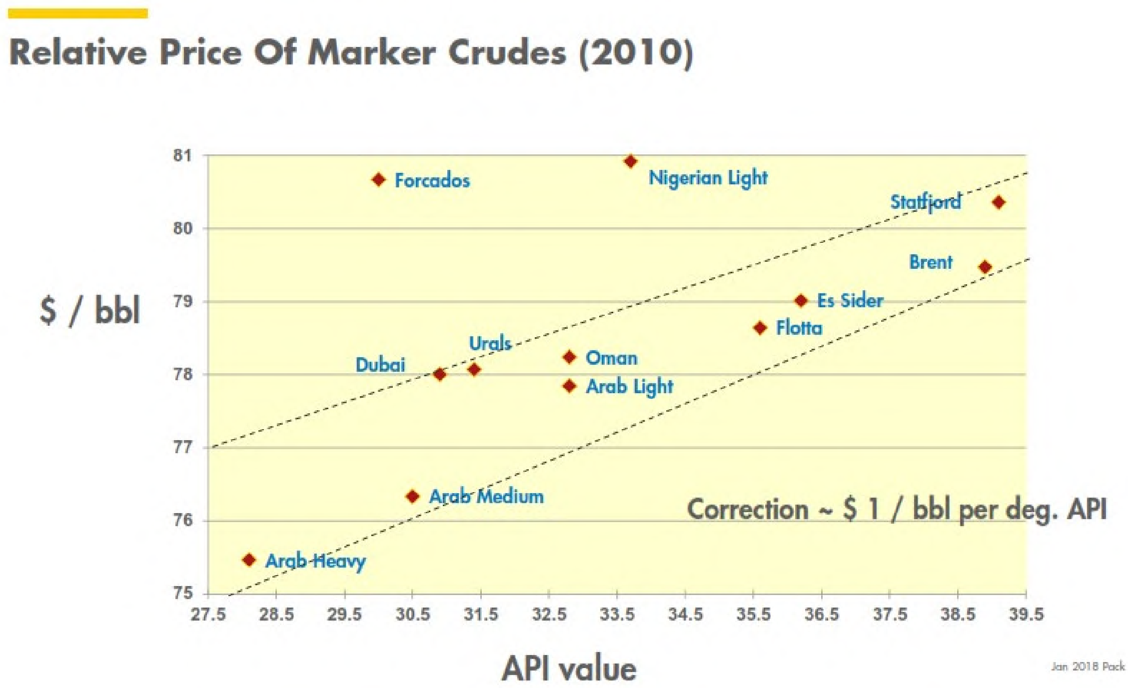


Figure 32 – Chart of 2010 crude oil price as a function of the oil's API (density) demonstrating the "premium" paid for "lighter" (higher API) oils, impacting a Development's economics.[264]

257. Before the Shenandoah discoveries, the other Lower Tertiary reservoir discoveries in the Gulf of Mexico deepwater had encountered Wilcox-aged turbidites that had poorer reservoir and fluid properties than previous discoveries in the younger-aged reservoirs as shown in **Table 5**, below:

[263] OMOTED Training Compilation - 2018.

[264] *Id*.

CONFIDENTIAL

Select Paleogene Reservoir Profiles									
Protraction Area	Field	Subsea Depth (ft)	Average Pay Thickness (ft)	Initial Pressure	Initial Temp. (˚F)	Initial GOR (scf/stb)	Porosity	Permeability (md)	Oil Gravity (˚API)
Walker Ridge	Cascade[1]	25,358	107	18,273	169	150	0.18	40	24
	Chinook[1]	25,600	201	18,447	166	150	0.23	31	24
	Hal3				203	150			
	Jack[1]	27,000	140	19,374	224	150	0.16	14	25
	Julia[4]	24,606			203	150			27
	Saint Malo[1]	27,154	185	19,023	225	150	0.17	14	28
	Stones[1]	26,826	210	19,196	199	366	0.17	30	

1.Except where noted, information downloaded from Knowledge Reservoir's *ReservoirKB* database June 11/10.

Table 5 – Summary of Walker Ridge Lower Wilcox characteristics, reservoir and fluid properties.[265]

258. The combination of "high quality reservoir and fluid properties" implies that recovery factors at Shenandoah would very likely be better than those at other Lower Wilcox Developments. Recovery factors directly impact the ultimate volumes that can be produced and are one of the more difficult factors to estimate prior to actual production of the reservoir.

259. Anadarko's Shen-2 well penetrated an exceptionally thick, stacked set of hydrocarbon-bearing reservoirs with good properties and high-quality oil, compared to other Gulf of Mexico Lower Tertiary Wilcox discoveries.[266] The Shen-2 well encountered "[e]xcellent [r]eservoir [q]uality"[267] as determined from the well logs and agreed by the partners: "Shenandoah 2 - Highest Net Pay of any Wilcox well to date and within top tier of deepwater GOM discoveries."[268] The reservoir quality of the Shenandoah wells is among the best for any Gulf of Mexico Paleogene discovery.[269]

[265] APC-00257632 at -765.

[266] APC-00002305 at slide 71.

[267] APC-00014422 at slide 1.

[268] ANACOP00008087 at slide 14.

[269] APC-00704016 at slide 11; APC-00002161 at slides 11-12.

CONFIDENTIAL

Wilcox Well Comparison						
	Jack	St Malo	Cascade	Chinook	Stones	Shen 2
GOR (scf/stb)	250	198	175	200	250	**1261**
Viscosity	3.14	2.42	6.42	5.99		**0.89**
Pi (Psia)	19,318	19,526	19,149	18,826		**22,755**
Net Pay H	831	344	331	283		**1001**
Avg Porosity (PHIE)	0.18	0.16	0.1	0.18	0.17	**0.211**
Avg Permeability	32	17	30	66	30	**50**

Table 6 – Wilcox Well comparison of reservoir and oil properties following the Shen-2 well.[270]

260. This comparison to other Gulf of Mexico fields demonstrates the "good quality" of the Shen-2 reservoirs and fluids. Note the higher GOR, Net Pay, and Average Porosity of the Shen-2 well compared to earlier Lower Tertiary discoveries, despite Shenandoah's greater burial depths and pressures, which more commonly is associated with poorer rock quality than what was encountered here.

261. Fluid quality is assessed through a series of properties that impact how they will flow, how they will behave with changes in temperature and pressure, and what their chemical composition consists of. "Good quality" oils are oils that typically have API's that are above 20 and that have Gas-Oil-Ratios (GORs) above 300. These key fluid quality factors are defined as follows:

- API - API gravity is a commonly used index of the density of a crude oil. API stands for the American Petroleum Institute, which is the industry organization that created this measure. API is calculated from a hydrocarbon's specific gravity using

[270] APC-00002305 at slide 71.

this formula: API = (141.5/Specific Gravity) - 131.5.[271] A crude oil will typically have an API between 15 and 45 degrees. Higher API indicates a lighter (lower density) crude. Lower API indicates a heavier (denser) crude. Generally, lighter (high API) crudes are more valuable because they yield more high-value products when run through a refinery.

- "Light crude is typically in the 35-45 API range, which includes most of the highest valued crudes such as Brent and WTI. Crudes lighter than 45 are typically considered extra-light crude or condensates and are valued lower than light crude because they contain a lot of light ends such as propane and butane. A medium crude is in the 25-35 API range, and a heavy crude is in the 15-25 API range. Anything below 15 API would be considered an extra-heavy crude."[272]

- GOR - "When oil is produced to surface temperature and pressure it is usual for some natural gas to come out of solution. The gas/oil ratio (GOR) is the ratio of the volume of gas ("scf" [standard cubic feet]) that comes out of solution to the volume of oil — at standard conditions. The GOR is a dimensionless ratio (volume per volume) in metric units, but in field units, it is usually measured in cubic feet of gas per barrel of oil or condensate."[273]

- Viscosity - Viscosity is a measure of a fluid's resistance to flow; (stress)/(rate of shear).[274] "Viscosity can be conceptualized as quantifying the internal frictional force that arises between adjacent layers of fluid that are in relative motion. For instance, when a fluid is forced through a tube, it flows more quickly near the axis of the tube than near the walls."[275] In general, viscosity depends upon the fluid's temperature, pressure, and rate of deformation. It is important in describing how easily an oil can move through the connected pores of a reservoir and influences production rates and recovery efficiencies.

262. The fluid properties measured at each step of the appraisal process at Shenandoah were generally described as follows: "Reservoir pressures: ~23K psi range; Res[ervoir] temp: 210

---

[271] Schlumberger Energy Glossary – *API Gravity*.

[272] Energy Insights by McKinsey, Tim Fitzgibbon, www.mckinseyenergyinsights.com/resources/refinery-reference-desk/api-gravity.

[273] "Glossary of Terminology Related to Responsible Gas," Colorado School of Mines, Payne Institute of Energy Policy, January 31, 2022.

[274] Encyclopedic Dictionary of Applied Geophysics – Definition "Viscosity."

[275] Williams, Jeffrey H., "Continuum Forces," Chapter 8 in Dimension Analysis: The Great Principle of Similitude, IOP Publishing, 2021.

(comparably low); Fairly good fluid prop[ertie]s especially in upper sands; Overall viscosities range from 0.5 – 3 cP (In upper Wilcox heavier as you move East)." (*See* **Table 7**below.)

Well	Zone	MD (Ft)	P res (Psia)	T res (F)	API (SSF)	GOR (scf/stb)	Viscosity (cp) Res Cond	AOP (Psia) @ Tres
Shen 1	LW D – LW E	29,348 – 29,620	22,635 – 22,892	190	26.1 – 26.3	852 – 867	3.07 – 3.36	8,465 – 8,635
Shen 2	UW 2 – LW B	29,329 – 30,323	22,798 – 23,185	197 -207	32.9 – 33.6	1,202 – 1,332	0.84 – 0.89	11,496 -11,908
	LW C	30,589	23,301	210	35.4	1,448	0.48	11,719
	LW D	30,892	23,497	212	36.6	1,819	0.49	13,480
	LW E	31,068	23,663	214	24.3	734	1.19 – 3.5 (IFA)	5,545
Shen 4	UW 2 – LW B	30,603 – 30,953	23,220 – 23,348	209-213	32.6 – 34.2	1,264 – 1,424	0.74	12,570
	LW C	31,296 – 31,503	23,359 – 23,701	217 – 219	37.3 – 37.4	1,840 – 1,949	0.44	14,012
	LW E	No sample or IFA – using gas isotope evaluation, fluid properties assumed to be similar to Shen 2 LW E						
Shen 5	UW 1 – LW B	28,754 – 29,910	22,569 – 22,982	183 – 201	29.1 – 32.7	1027 – 1217	1.15 – 1.92	12,290 – 12,996
	LW C – LW E	30,236 – 30,759	23,103 – 23,418	203 – 214	23.7 – 27.6	690 - 780	Results not yet available	

- **Shen 5 - Samples measured for H2S in each sand – results show no detectable H2S**

Table 7 – Comparison of reservoir and oil properties measured from each Shenandoah well.[276]

263. Fluid properties were assessed as "good" after drilling at Shen-2 and at each step of the appraisal program thereafter. No siderite, a mineral that can be an indication of hydrocarbon migration, was detected in the core analyses**.**[277]

264. Although Plaintiffs state that one of the alleged "omissions" is that "the fluid quality from the Shenandoah appraisal wells was poor"[278], as set forth in the above discussion the available documents disprove that assertion.

c. *Amended Complaint ¶ 32: "[T]he Shenandoah Basin [] has the potential to become one of the most prolific new areas in the deepwater Gulf of Mexico"*

265. Plaintiffs challenge an Anadarko issued Press Release on March 19, 2013, that quoted Mr. Daniels as saying: "The successful Shenandoah-2 well marks one of Anadarko's

[276] APC-01228478 at slide 14.

[277] *See, e.g.*, Marathon_012009; *see* Chandler Dep. Tr. Exhibit 215 p. 3; Chandler Dep. Tr. at 236:13-21.

[278] Dkt. 55 - Amended Complaint, ¶ 95(c).

largest oil discoveries in the Gulf of Mexico, with more than 1,000 net feet of oil pay and reservoir rock and fluid properties of much higher quality than previously encountered by industry in Lower Tertiary discoveries . . . . With ownership in the successful Shenandoah wells, the adjacent Yucatan prospect, and the very encouraging results from the nearby Coronado well, Anadarko is strategically positioned in the Shenandoah Basin, which has the potential to become one of the most prolific new areas in the deepwater Gulf of Mexico."[279]

266. The Shenandoah basin is a tertiary sedimentary basin that is enclosed on basin edges and from above by (allochthonous) salt. The structure of the basin allowed for hydrocarbons to be trapped in various places along the edges of the basin. Early Discoveries at Shenandoah, Coronado, and Yucatan, all within the Shenandoah basin, along with the thick oil column see at Shen-2, provided optimism that this basin could be extremely prolific for production of hydrocarbons in the Gulf of Mexico.

267. By 2013, the Shenandoah basin included three prospective discoveries: Shenandoah, Coronado, and Yucatan. The statement therefore refers to these three discoveries combining to make the Shenandoah basin an area with one of the highest volumes in place in the deepwater Gulf of Mexico.

268. Post Shen-2 well, along with the other results in the Shenandoah basin, placed P50 recoverable volumes for the Basin at: Shenandoah – 1197MMBO; Yucatan – 287MMBO; and Coronado – 417MMBO.[280] This P50 total of 1901MMBO certainly did present the potential for it to be "one of the most prolific new areas in the deepwater Gulf of Mexico."

d. *Amended Complaint ¶ 34: Anadarko's Exploration team had "900+ MMBOE Net Discovered Resources" in 2013, a third of*

[279] Dkt. 55 - Amended Complaint, ¶ 32.

[280] APC-00000671 at slide 36.

CONFIDENTIAL

which was attributable to Shenandoah"

269. Plaintiffs challenged a slide shown by Anadarko at the March Investor Conference that "provided inflated estimates of the Shenandoah resource, which were far too optimistic given the available data and science. One slide boasted of Anadarko's "'900+ MMBOE Net Discovered Resources' (a third of which was attributable to Shenandoah)."[281] The slide referred to the following:

Figure 33 – Slide referred to in Plaintiffs' Amended Complaint referencing "900+ MMBOE Net Discovered Resources."[282]

[281] Amended Complaint, ¶ 34.

[282] March 4, 2014 Investor Relations Conference Presentation, APC-00605965 at slide 74.

270. This slide is referring to Anadarko's Worldwide Exploration and Appraisal successes in 2013. It specifies both "Net Discovered Resources" (Anadarko's global net share of discovered resources not previously reported) and "Net Resources moved to Development" by the Exploration Team.[283] It notes that "Net Discovered Resources" includes a significant number of new deepwater discoveries, in addition to added "Appraised Resources" that includes Shenandoah.

271. Additionally, Plaintiffs claim that the "slide boasted of Anadarko's '900+ MMBOE Net Discovered Resources' (a third of which was attributable to Shenandoah)," but it is unclear whether Plaintiffs are referring to volumes attributable to the Shenandoah discovery or the Shenandoah basin, which includes the Coronado and Yucatan discoveries. It is also not clear from the Plaintiffs' verbiage or the documents available where the Plaintiffs' reference to "a third of which was attributable to Shenandoah" was derived from.

272. Regardless, the slide does not specify a detailed breakdown of how much of each resource is attributable to each opportunity. There is no specific assignment of volumes added to from the Shen-2 appraisal, and there is no reference to any assignment of volumes that indicate "a third of which was attributable to Shenandoah."

273. Anadarko's Exploration Gulf of Mexico Resource Tracking Sheets[284] indicate that Anadarko's Exploration team had transferred 41 MMBO (16.8 MMBO plus 24.2 MMBO) to Development prior to the drilling of the Shen-2 appraisal well. After the Shen-2 success, Exploration noted an additional 86.9 MMBO to their Discovered Resources for 2013. The same document also shows 21.4 MMBO attributable to Phobos and 29.9 MMBO attributed to Coronado

[283] "Net discovered" resources represent Anadarko's share of each of the year's additional "discovered" proven, probable and possible resources. The presentation does not clearly indicate if these references are likely being made to "net risked in-place" volumes or "net risked recoverable" volumes.
[284] APC-01204634.

also in 2013 in the deepwater Gulf of Mexico, for a total of (86.9 MMBO + 21.4 MMBO + 29.9 MMBO = 138.2 MMBO) attributed to Deepwater Gulf of Mexico Exploration in 2013.[285]

EXPLORATION IDENTIFIED RESOURCE TRACKING (2004- present)											
									Estimated by Reservoir Engineer	Actually Transitioned	
Year of Discovery	Region	Area	Field	Well	Spud Date	TD Date Rig Release Date	Discovery	Current Status	Mean Net Truncated Resources (MMBOE)	Transitioned to Development (MMBOE)	Under Appraisal (MMBOE)
2008	GOM	USGOM	Shenandoah	**Shenandoah pre-drill**		Dec-08	Discovery	Transitioned	16.8	16.8	
2009	GOM	USGOM	Shenandoah	**Shenandoah post-drill incremental**		Feb-09	Discovery	Transitioned	24.2	24.2	
2013	GOM	USGOM	Phobos	**Phobos**	Nov-12	May-13	Discovery	Under appraisal	21.4		21.4
2013	GOM	USGOM	Shenandoah	**Shenandoah A2**	Sep-12	Jan-13	Discovery	Under appraisal	86.9		86.9
2013	GOM	USGOM	Coronado	**Coronado 1**	Jun-12	Jan-13	Discovery	Under appraisal	29.9		29.9
2014	GOM	USGOM	Shenandoah	**Shenandoah 3 Appraisal**	May-14	Dec-14		Transitioned	50.0	50.0	
2014	GOM	USGOM	Coronado	**Coronado 2 Appraisal**	Dec-14	May-14		Under appraisal	0.0		0.0
2014	GOM	USGOM	Yucatan	**Yucatan 2 Appraisal**	Mar-14	Jun-14		Under appraisal	23.0		23.0

Table 8 – An excerpt from Anadarko's Exploration Resource Tracking sheets showing the resource volumes transitioned to Development associated with Shenandoah basin and total during 2013.[286]

274. Anadarko's Resource Exposure Sheets from 2013[287] verify Exploration's volumes from Deepwater Gulf of Mexico at 138 MMBO, and additionally identify International Deepwater Exploration volumes of 26 MMBO from Brazil and 755 MMBO from Mozambique for an international total of 781 MMBO.

275. This demonstrates that Anadarko's Deepwater total for 2013 was 919 MMBO (138 MMBO + 781 MMBO). It is this "900+ MMBOE Net Discovered Resources" that Mr. Daniels refers to, of which Shenandoah's 87 MMBO amounts to less than 10% of the total.

---

[285] *Id.*

[286] *Id.*

[287] APC-01672140.

There is no evidence that Mr. Daniels or Anadarko ever claimed that of the 900+ MMBOE Discovered resource added by Exploration in 2013 "a third of which was attributable to Shenandoah."

276. Estimated recoverable volumes are a product of estimates of oil in place (STOOIP) and recovery factor. As discussed above, estimation of recovery factors is a complex process that depends upon the reservoir and fluid properties, the geometry and connectivity of the reservoir, the size and connectivity of the downdip aquifer, and the choice of a specific economic Development design. As more appraisal subsurface data is collected and Development design decisions are matured, the estimated recoverable volumes can change significantly. Ultimately, only after significant production over the life of the field can an accurate "Recoverable Volume" be assured.

e. *Amended Complaint ¶ 34: The Shenandoah Basin represented a "~2-4 Billion Net Opportunity"*

277. Plaintiffs challenge the following slide shown by Anadarko at a March 4, 2014, investor conference that "described the Shenandoah basin alone as a "~$2 - $4 Billion Net Opportunity":[288]

[288] Dkt. 55 - Amended Complaint, ¶ 34.

CONFIDENTIAL

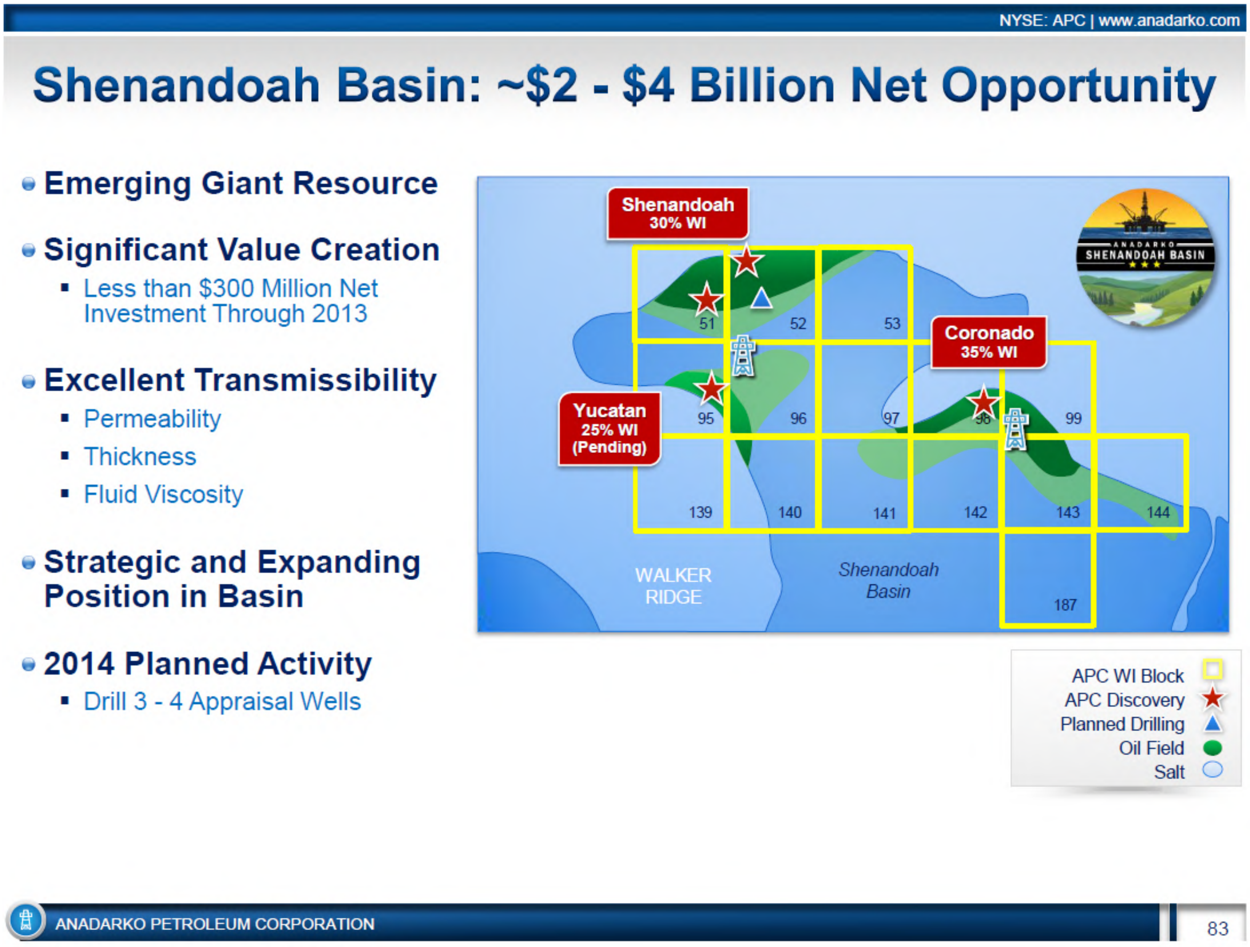


Figure 34 – Presentation slide cited by Plaintiffs referencing a "~$2 - $4 Billion Net Opportunity" for the Shenandoah basin.[289]

278. A "~$2-$4 Billion Net Opportunity" represents an assessment of net economic profit that accounts for production and sale of the net exploration volumes at Shenandoah (APC 30% working interest), plus the net exploration volumes at Yucatan (APC 25% working interest), plus the net exploration volumes at Coronado (APC 35% working interest).[290]

279. "Net exploration volumes" for the Shenandoah basin at the time of this statement can be calculated as follows:

[289] March 4, 2014 Investor Relations Conference Presentation, APC-00003046 at slide 83.

[290] APC-00001505 at slide 2.

Basin Discovery	P50 Volume	APC Working Interests	"Net Exploration Volumes"
Shenandoah	1197 MMBO	30%	359 MMBO
Coronado	417 MMBO	35%	146 MMBO
Yucatan	287 MMBO	25%	72 MMBO
Total			577 MMBO

Table 9 – Net Exploration Volumes for Shenandoah basin[291]

280. In February 2014, the Anadarko Exploration team assessed the economics of the Shenandoah Field potential development of 949MMBO recoverable volume as delivering a Net Present Value for Anadarko of $2.3 billion (at 10% discount) with a Profit-to-Investment ratio of 1.4.[292] This assessment included only the Shenandoah field, and if one were to extrapolate the same level of profitability to the Coronado and Yucatan volumes, an estimate of the Basin representing a "$2 - $4 billion net opportunity" is seen to be entirely reasonable.

4. Rebuttal to Merrill Opinions re: Shen-2:

281. **Merrill Opinion re: Shen-2:** With respect to Shen-2, Merrill opines that Anadarko had overly optimistic resource estimates as it announced that the Shenandoah basin was a $2 to $4 billion opportunity. Merrill further opines that around this time, Anadarko Exploration ignored the risk of faulting.

282. **Rebuttal to Merrill Opinion re: Shen-2:** While Merrill does not conduct any analysis of the underlying estimates that went into Anadarko's $2 to $4 billion statement, my own

[291] APC-00001505 at slide 2.

[292] APC-01674681 at slide 5.

review reflects that it was reasonable at the time based on Anadarko's early estimates. Merrill's opinion that Anadarko "ignored" the risk of faulting is not supported by the evidence; rather, Anadarko Exploration and Development had different approaches to mapping. Before the start of the Class Period, Anadarko Exploration mapped a potential north-south fault splitting the reservoir into east and west compartments.

283. **Merrill ¶ 21:** "Leading up to the Class Period, Anadarko created the public perception that Shen was one of the largest commercial oil-field discoveries in deepwater GOM. Following the drilling of the first appraisal well, Shen-2, in March 2013, Anadarko indicated the Shen basin was a $2-$4 billion opportunity. This announcement set the public's perception, including myself, that this was a new 'giant' field. It was considered so significant that Defendant Ernie Leyendecker was invited to speak at the American Association of Petroleum Geologists Discovery Thinking Forum on the Shen discovery at the 2014 AAPG annual convention, where he talked about the very large resource that Anadarko had at Shen (Appendix IV)."

284. **Rebuttal to Merrill ¶ 21:** Merrill opines in his report that Anadarko created a misleading impression of the size of the Shenandoah resource. The discussion and documentation of alleged misstatements in Section 3.d, above, clearly demonstrates that, with the volumetric assessments at the time for Shenandoah basin, including the Shenandoah, Yucatan, and Coronado prospects/discoveries, an estimate of a potential "$2-$4 billion opportunity" was reasonable. This estimate was consistent with the 2014 volume recovery calculations of Anadarko's Exploration team, which assessed the economics of the Shenandoah basin alone as 949 MMBO of recoverable volume that would deliver a Net Present Value for Anadarko's share of $2.3 billion (at 10% discount) with a PIR of 1.4.[293] Any Yucatan or Coronado volumes would only increase these

[293] APC-01674681 at slide 5.

positive economic values. It is clear from the documents that Anadarko evaluated the Shenandoah basin opportunity using their best technical ability and based on the best available information at the time. Merrill does not provide any substantive evidence to show that the description of the Shen basin as a "~$2 - $4 billion opportunity" was untrue or not supported by the facts of the day. As stated above, in my professional opinion, early statements about Shenandoah being a $2 to $4 billion opportunity were supported by the information available at the time.

285. **Merrill ¶ 27:** "During the relevant time period, Anadarko operated Shen with partners ConocoPhillips, Cobalt, Marathon, and Venari. Initially, Anadarko's exploration group mapped Shen as an unfaulted, homoclinal, southward-dipping structure on the north side of the basin. Anadarko clung to this overly simplistic structural picture, despite ample evidence of faulting and compartmentalization, leading to exaggerated statements about Shen's likelihood of successful development, resource size, and value."

286. **Rebuttal to Merrill ¶ 27:** Each of the Shenandoah partners mapped the structure with "homoclinal dip" from north to south, although with some level of faulting that was added or removed over time. In structural geology, a "homocline" is a geological structure in which the layers of a sequence of rock strata dip uniformly in a single direction, having generally the same inclination in terms of direction and angle.[294] Since there are no mapped or measured "dip reversals" in the sediments layer structural maps, characterizing Shenandoah as "homocline" is accurate. Anadarko Exploration began mapping an east-west fault between Shen-1 and Shen-2 based on evidence from Shen-2, and they began mapping a north-south fault between Shen-2 and Shen-3 when improved seismic indicated a likely fault downdip of any well control.[295] Anadarko

[294] SEG Wiki – *Homocline.*

[295] APC-00147996 at slide 2.

Exploration's maps represented the information that the team felt met the standard of being was "confidently known" rather than including any and all interpretations which that were speculatively possible.

287. **Merrill ¶ 47:** "Based on my review, substantial evidence existed early on of significant faulting at Shen. The geology and geoscience revealed that: (1) MDT pressures indicated that OWC's could not be extrapolated across the field; (2) pressure breaks were indicating a completely broken field; and (3) there was increasing evidence of a sealing fault from seismic imaging and the OBMI data. This made Shen more difficult and expensive to appraise while also portending bad news for recoverable oil and associated economics. For example, Doug Shotts' August 19, 2014 presentation concluded that the combination of heavy north-south faulting combined with mild east-west faulting might reduce the recovery factor to 5% and by -81% for a given volume of oil in place compared to the unfaulted base case."

288. **Rebuttal to Merrill ¶ 47:** To the extent Merrill suggests that the data prior to drilling Shen-3 indicated "significant faulting," he overstates both the strength and certainty of the evidence. The evidence discussed in the following paragraphs indicates that the seismic data was poor, which led individuals at Anadarko to speculate that there could be faulting—the extent of which would need to be defined by further appraisal wells. Faulting is always a concern in deepwater Gulf of Mexico drilling; Anadarko understood this and sought to better understand faulting through appraisal drilling and improved seismic. Contrary to Merrill's suggestion, the pressure data did not indicate a fault that sealed through the aquifer, and I am not aware of evidence that anyone at Anadarko concluded it did. While Merrill claims that this evidence of faulting "made Shen more difficult and expensive to appraise while also portending bad news for recoverable oil and associated economics," he provides no support for this assertion. This was early in the

appraisal process, and it was well understood that Anadarko and the partners needed conduct additional appraisal to understand the prospect. Finally, as discussed above, Mr. Shotts's reservoir simulations leveraged artificial (*i.e.*, nonexistent) faults for purposes of demonstrating possible outcomes, and contrary to Merrill's suggestion, were not intended to be conclusive observations about the subsurface structure.

289. **Merrill ¶ 48:** "Anadarko was aware of potential faulting at Shen before the Class Period began. For example, by the Spring of 2014, Anadarko geoscientist Arnold Rodriquez had mapped the Shen area with a significant number of faults cutting the prospect. This demonstrates that Anadarko was aware of faults in Shen that, in my expert opinion, would impact the development plan. Additionally, partner communications identified faults and potential fault compartments by the Spring of 2014."

290. **Rebuttal to Merrill ¶ 48:** Merrill is correct in stating that Anadarko Exploration was aware of potential faulting after the drilling of Shen-2 given the obvious barrier between Shen-1 and Shen-2 and the weak seismic indications of downdip discontinuities in the center of the basin. However, with no specific, verifiable faults penetrated in Shen-2, without clear seismic evidence that was mappable within the area of the trapped up-dip reservoirs, and without clear evidence of where to position any potential faults (other than the east-west fault/weld between Shen-1 and Shen-2), Anadarko Exploration decided not map uncertain faults that could be wrong. Plainly, the team was aware of this uncertainty and anticipated it would be addressed by the improved seismic project and additional appraisal drilling.

291. **Merrill ¶ 49:** "On March 26, 2014, Rodriguez warned McGrievy and Frye that there were probably more faults than he was able to map given the current seismic imaging quality:

> Subject: Shenandoah Upper Wilcox Structure
>
> Mapping update with the current volume. This is the faulted version and realize that there probably are more faults than I am able to map with the current seismic imaging."

292. **Rebuttal to Merrill ¶ 49:** This reference to Mr. Rodriguez's difficulties with mapping because of the poor quality of the seismic image supports Anadarko Exploration's viewpoint that the location and sealing capacity of potential faults at Shenandoah was an uncertainty to be addressed by seeking better seismic and additional well data.

293. **Merrill ¶ 50:** "On March 31, 2014, Browning responded to Rodriguez's recent structural and fault interpretation. Browning made an important point that faults with small offsets can be sealing, given the potential for deformation banding in 50 mD permeability rock. When fault offset exceeds the gross thickness of the sands, the result will generally be that the fault seals, forming a no-flow barrier with sand on shale contact across the fault. Where fault offset is less than the sand thickness, sand-on-sand contact may or may not be sealing. Deformation banding is where rock is crushed from pressure and movement along the fault, reducing its permeability and potentially causing the fault to seal, even when sand is juxtaposed against sand. Given the noise in the seismic data, Browning also questioned whether the reservoir is 'completely broken up' or is it an artifact of noisy data.

> The pink fault is anchored on a deep event with significant offset but looks to be dying shallow. The red fault looks to have significant offset, but only through one horizon. Really, none of the shallow faults completely offset the Wilcox section. But with deformation banding in 50 md rock, small faults might create drainage compartments. There's a lot of noise swinging through the data. Is the reservoir completely broken up by faulting or noisy data? I wonder if we'll know which is the case until a good number of wells are on production. But certainly, if we get more pressure breaks between appraisal wells, we'll have our answer."

294. **Rebuttal to Merrill ¶ 50:** Merrill's opinion extends far beyond the concern expressed by Mr. Browning about Mr. Rodriguez's difficulties with his fault mapping. Certainly,

Mr. Rodriguez was unable to satisfactorily map the faulting in the basin, noting his conclusions speculatively, (*e.g.*, "The pink fault . . . looks to be dying shallow," "The red fault . . . only through one horizon," etc.) and commenting that "[t]here's a lot of noise swinging through the data."[296] However, Merrill's conclusion that when fault offset exceeds gross sand thickness, "the result will generally be that the fault seals" is far too simplistic for this depositional system. It is just as, or even more, likely that any number of possible fault offsets will juxtapose one sand against the same or another sand in such a dominantly sandy interval. In these situations, a proper "fault seal analysis" with the use of Allan Diagrams[297] is necessary.

295. **Merrill ¶ 51:** "Browning then questioned whether the reservoir was broken up or just noisy data. In addition, Browning made a very important statement that should have been revisited by Anadarko professionals and management after each appraisal well regarding the significance of 'pressure breaks' between wells. Each time a new appraisal well proved to be isolated from its neighbors, this added a significant negative finding establishing fault compartmentalization."

296. **Rebuttal to Merrill ¶ 51:** Merrill implies that reservoir compartmentalization was not properly considered by Anadarko with his statements that "Anadarko professionals and management" "should have . . . revisited" "whether the reservoir was broken up or just noisy" "after each appraisal well." The facts indicate that Anadarko's technical teams did recognize and account for reservoir compartments as they were identified after each new data set (seismic, wells and lab) became available. This was reflected in the chronology of the mapping, in the reduction of recovery factor, and in the range of modeling and simulation scenarios that were tested.

[296] APC-00004880.

[297] AAPG Wiki – *Fault Seal Analysis for Reservoir Development – Allan Diagrams.*

297. **Merrill ¶ 52:** "Rodriguez responded in the same email chain with the comment that he thought the reservoir was completely broken up as Browning had speculated.

> The interpretation is not completed, and some faults have not been fully assessed from the interpretation standpoint. In general, the pink fault on the seismic is approximately 150-220' fault as observed with this 'raw' version of processed seismic.
>
> I think the reservoir is completely broken as you put it. I want to have the team with Van to look at the effect of mother salt evacuation from the area of the sediment entry point, to and along the axis of Wilcox deposition.
>
> There may be two sets of faults. Large faults were active during deposition (syn-depositional), and the numerous smaller scale faults 50-100' are all post depositional or formed primarily to fill the hole formed by the evacuated deep mother salt."

298. **Rebuttal to Merrill ¶ 52:** Neither Merrill, Mr. Rodriguez nor Mr. Browning specify exactly what they mean by "completely broken." Clearly, even a single fault that offsets the entire Wilcox reservoir section will make it "completely broken" (*e.g.*, in half), and Mr. Rodriguez's assessment of the pink fault could be characterized that way. However, Mr. Rodriguez's hypothetical "two sets of faults"[298] was disproved by subsequent wells that demonstrated lateral consistency in sand thicknesses. If there were "large faults [that] were active during deposition (syn-depositional)" then sand thickness would be much greater in those fault blocks that were downthrown and thinner on the upthrown side. This is not what was observed in the subsequent appraisal drilling, where even across interpreted faults, most sands maintained stable thicknesses laterally (*e.g.*, from Shen-2 to Shen-5, Shen-6, and Shen-3, respectively).

299. **Merrill ¶ 53:** "An email exchange dated April 1, 2014 shows how important fault interpretation was to determining future appraisal well locations. Jake Ramsey, a geologist on the Exploration team, was included in the exchange with Browning quoted as follows:

[298] Expert Report of Robert Merrill, ¶ 52.

> If the 'Pink' fault seals, the oil-water contact in the S3 [Shen-3] fault block is independent from the S2 [Shen-2] fault block.
>
> If we receive Yucatan pressure data in the aquifer, we should have an estimated oil-water contact based on gradients from S2 [Shen-2], but it will not necessarily be relevant for the S3 [Shen-3] fault block.
>
> If we find that the estimated contact is above the planned S3 [Shen-3] penetration, intentionally drilling a wet S3 [Shen-3] test will do nothing to definitely test the large S3 [Shen-3] fault block.
>
> We cannot assume there is oil above us at S3 [Shen-3]. (In K2 for example, the north fault block is HC charged in the M14 but the south fault block is wet.)
>
> With effectively only one well in our reservoir, I think confirming HC pore volume is still our first priority. Testing aquifer properties might be important, but only after confirming commercial OIP.
>
> I believe the sensible approach is to not "finalize" the S3 [Shen-3] bottom-hole location until we have data from Yucatan. And if the projected contact is at a level between S2 [Shen-2] and S3 [Shen-3], we should move S3's [Shen-3's] BHL to target above this notional OWC."[299]

300. **Rebuttal to Merrill ¶ 53:** Merrill is correct in his assessment that fault interpretation is important to the planned location of appraisal wells. His statement supports the reason why Anadarko Exploration did not put speculative faults on their maps. Moreover, his reference to the email above demonstrates the significant hindsight bias that he brings to his analysis. Specifically, Merrill argues repeatedly that there was contemporaneous evidence of "significant faulting" that would have made pressure connectivity between up-dip wells and downdip aquifers unlikely. In this email, Mr. Browning argues that the Shen-3 well bottomhole location should be determined based upon pressures across the basin at the Yucatan field. For these pressures to have any bearing in the Shen-3 planned location, pressure connection from up-dip Yucatan though the downdip aquifer to the up-dip Shen-2 well must be assumed. Merrill conveniently ignores this point. In fact, due to operational constraints, the spudding of Shen-3

[299] APC-00004964.

could not be delayed, as this proposal was made less than 2-months before the planned spud date. In addition, Anadarko checked with the Drilling Department and determined that the top-hole location could not be moved without refiling with the Federal Government for approval. Finally, the bottomhole location could not be repositioned significantly up-dip due to the well's design. All of these issues left the Anadarko team without the ability to change the Shen-3 plan.

301. **Merrill ¶ 54:** "The pink fault is depicted in Figure 10, which was part of a presentation by Rodriguez subtitled 'Complexly Faulted Model.' Colored lines depict faults in the seismic cross section, and white linear features depict faults in the colored structure map."

302. **Rebuttal to Merrill ¶ 54:** Mr. Rodriguez interprets numerous faults on this seismic traverse, where offsets on horizons are interpretable at some levels and more challenging at others. In my expert opinion as a geophysical interpreter, interpreting faults on this noisy seismic data is extremely challenging. However, I also note that without accessing the seismic volume directly, it is impossible to truly verify the quality of this or any interpretation. This traverse shows the "pink" fault crosses at an area far downdip of the Shen-2 well and far below the prospective reservoir level. Mr. Rodriguez's map shows various faults at different orientations between Shen-2 and Shen-3 that are different than other faulted maps suggested by Anadarko's partners. The slide questions whether the potential "pink" fault is sealing or not, which cannot be determined with any certainty with the data available.

303. **Merrill ¶ 55:** Merrill also references the Development team's Upper Wilcox structure map[300] from the same presentation which "shows [Mr.] Rodriguez's interpretation of the fault structure at the top of the UW1 horizon, providing outlines of the S2 and S3 fault blocks. Faults are shown as white linear features. This same structure map with development's

[300] APC-00117313 at slide 3.

interpretation of faulting was presented to Kleckner on or after April 3, 2014, based on the file name."[301] Merrill references the following map:

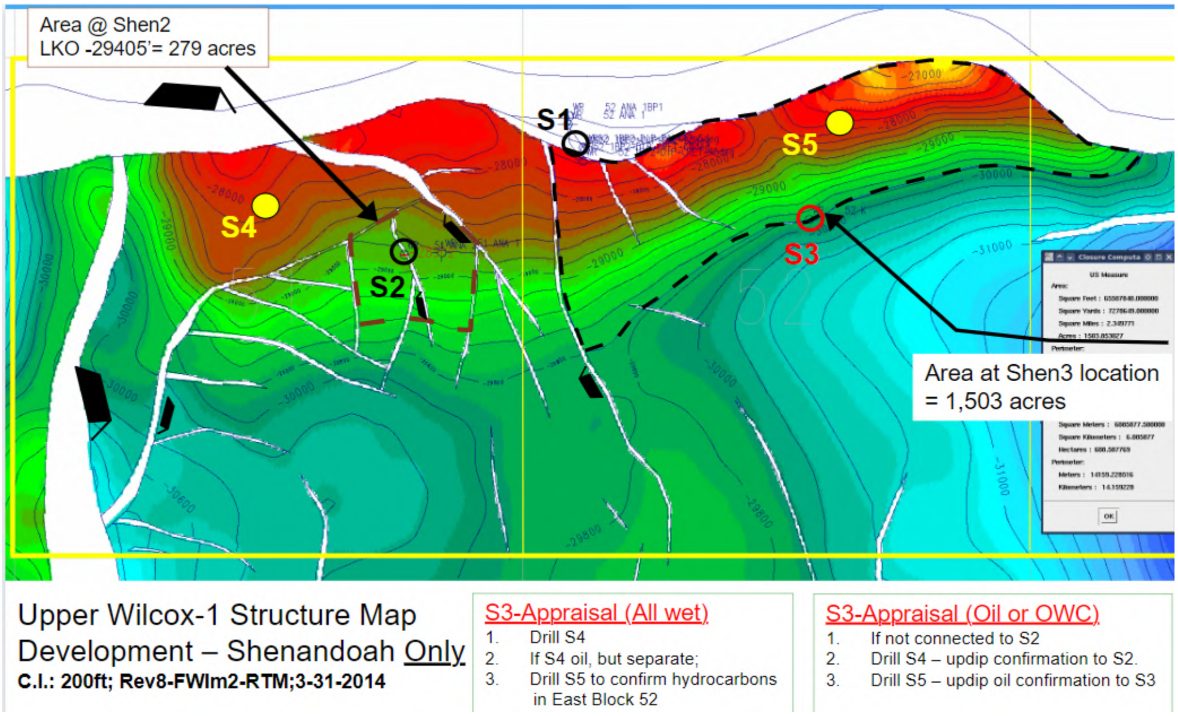


Figure 35 – Mr. Rodriguez's map presented to Mr. Kleckner.[302]

304. **Rebuttal to Merrill ¶ 55:** This map by Mr. Rodriguez depicts a number of faults but focuses on the "pink" fault between Shen-2 and the proposed Shen-3 location. The dashed line defines the area of potential oil located east of the "pink" fault. There are a number of interesting features of this map:

1) If the "pink" fault seals, it separates any oil column at Shen-2 from oil in Shen-3 (S3).

2) The "pink" fault does not isolate aquifer in the center of the basin and is consistent with Shen-2 well likely being in pressure connection with the Shen-3 location.

[301] Expert Report of Robert Merrill, ¶ 55, Fig. 11.

[302] APC-00117313 at slide 3.

3) This map indicates that the "pink" fault has, at most, 100ft of offset based upon contours that are drawn.

305. **Merrill ¶ 56:** Merrill references an April 1, 2014 email from Mr. Browning to Mr. Ramsey and Mr. Strickling in Exploration that includes an alternative, "'Complexly Faulted Model' and mention[s] that each fault block may have its own unique OWC and that each fault block will need to be tested with a well.

> Arnold is picking a number of faults, (as have our partners I believe). I can get you linked access to Arnold's map if you'd like.
>
> I'm suggesting that there is a 'possibility' that the up-coming Yucatan pressure data will indicate that our planned drill location will be wet.
>
> It's just one possible scenario. Other possibilities are that Yucatan aquifer pressures will indicate that Shenandoah is filled to spill; or if Yucatan is full-to-base it may not have any bearing on Shenandoah's contact, (although it might establish a new highest possible water level for Shenandoah).
>
> I'm just trying to encourage discussion on how we might use the information to our advantage. If Arnold's structural interpretation has any validity, **we can't assume other fault blocks have the same OWC. We have to test each fault block with a well, (starting with the biggest)**. If our projection when we spud S3 is that it will be drilling into the aquifer, I argue that it's not the optimum use of appraisal dollars.
>
> I've been told that Shenandoah wells cannot be sidetracked. If that's the case, and we anticipate drilling a wet well, I suggest we 'modify on the fly.'"[303]

306. **Rebuttal to Merrill ¶ 56:** This email exchange demonstrates that Exploration was not only aware of potential faulting but actively considered its implications, despite the fact that they had not yet formally put any north-south faults on their maps. They also note that faults may be sealing, and if so, that OWCs would vary. Mt. Strickling recognizes that this could be an advantage and some faults may have larger oil columns than Exploration had previously

[303] APC-00117310 (emphasis supplied by Merrill).

considered. Finally, Mr. Strickling acknowledges that the Shen-3 well cannot be sidetracked and suggests "walking" the well structurally up-dip to the extent it is possible.[304]

307. **Merrill ¶ 57:** "Ramsey responded to Browning about the lack of consensus around the impact of faulting on the structural interpretation, and that considerable information will be necessary for the various parties to converge on their interpretation."

> Thanks Brad. I'll check with Jim Kunning on IF the well has any bottom hole flexibility available.
>
> An important data point to consider though, is the raw lack of structural consensus (internally and externally) that currently exists at Shenandoah. I have seen eight different maps of Shenandoah from six different companies (two different maps internally), and the only similarity between the 8 is the overall 3-way shape. Attached are the maps from our Shen partners, that were traded several months ago. Unfortunately at the pace I am observing, we will likely not have a consistent map between all respective mappers, until a whole lot more data comes to light (final and consistent seismic to start, pressure data, FLAIR/geochemistry, and possibly even production PTA). Given all the structural uncertainties we currently have with everyone involved, I think it will be a very hard task to persuade a majority of parties (internally and externally) to modify the current bottom hole location of Shen-3, based purely on the Yucatan pressure data. I'll personally be looking at it hard and weighing the options appropriately, but I am mindful of the very complex dance that will ensue.
>
> **With all that said though, if any north-south faulting exists that could potentially compartmentalize Shenandoah, it would represent the largest risk element to appropriately appraising this project.** It's my opinion, that we should come to a consensus internally, on the probability of any potential faulting at Shenandoah, and particularly regarding the "pink" fault. **We're using the same data, we're all on the same APC GOM team, so there should be no real reason we can't reach a consensus. If we are aligned internally, then we will be able to make the appropriate appraisal decisions as operator.**" (emphasis supplied by Merrill)

308. **Rebuttal to Merrill ¶ 57:** Although Merrill emphasizes the acknowledgement by Mr. Ramsey that "if any north-south faulting exists that could potentially compartmentalize Shenandoah, it would represent the largest risk element to appropriately appraising this project,"

[304] *Id.*

the exchange also recognized the "lack of structural consensus" within Anadarko and among partners, and that Anadarko Exploration "will likely not have a consistent map between all respective mappers, until a whole lot more data comes to light."[305] It is clear from this exchange that Anadarko recognized the possibility of faulting and the current lack of data or consensus about how or where to interpret such structures.

309. The extent of Merrill's consideration of the significant differences in partner interpretations at this point in the appraisal is a brief reference to an early ConocoPhillips' map that has interpreted multiple east-west faults on it. Merrill simply notes the existence of ConocoPhillips' map as "[a]n example of a differing partner interpretation,"[306] but apparently fails to appreciate the significant conflict between this map and the one created by Mr. Rodriguez that Merrill discusses earlier in his report.[307] Again, relying on hindsight bias, Merrill simply opines that Mr. Rodriguez's map should have been adopted early on, and does not consider the fact that such conflicting structural differences, far from being evidence of "significant faulting,"[308] simply demonstrate the poor quality of the data, and the overall lack of certainty regarding the subsurface picture.

310. **Merrill ¶ 58:** "An example of a differing partner interpretation is ConocoPhillips' interpretation showing extensive east-west faulting in the top of the Wilcox structure map, shown in Figure 12."

311. **Rebuttal to Merrill ¶ 58:** Notably, this early map from July 2013 was soon replaced at ConocoPhillips with maps that no longer show these east-west faults (except for the

---

305 APC-00117318.

306 APC-00117345; Expert Report of Robert Merrill, ¶ 58.

307 Expert Report of Robert Merrill, ¶¶ 48-52.

308 *Id.* ¶ 47 p. 26.

east-west fault/weld between Shen-1 and Shen-2).[309] In fact, their earlier map showed no north-south faulting at all, which is the primary direction of faulting proposed during this time by Anadarko's Development team. The changing of interpretations within each partner's appraisal team again demonstrates the uncertainty in the interpretations and the reason why Anadarko Exploration was careful about putting any faults on their maps which could not be firmly defended.

312. **Merrill ¶ 59:** "Ramsey made a very important statement regarding the importance of fault compartmentalization in apprising the Shen field, stating that 'if any north-south faulting exists that could potentially compartmentalize Shenandoah, it would represent the largest risk element to appropriately appraising this project.' Ramsey forwarded this exchange to Trautman, his manager in exploration, and included the following comment: 'Paints a good picture on their value of the north south fault trending down the center of Shenandoah and how it impacts THEIR forward planning.' This statement indicates that the threat of faulting was not a concern of exploration, and only the development team considered it in their well planning logic. The emphasis of capitalizing 'THEIR' appears to dismiss the risk of faulting, representing faulting as development's concern and not exploration's concern. As a joint team, planning an appraisal program and evaluating project commerciality, compartmentalization by faulting impacts the number of wells and, ultimately, the capital investment required to produce the hydrocarbons. Accordingly, it should have been both team's concern."

313. **Rebuttal to Merrill ¶ 59:** Merrill's interpretation of the capitalization of the work "THEIR" is unsupported and as Merrill himself agrees, speculative.[310] Indeed, in his deposition Merrill testified in direct contradiction to his report that "I'm not saying it was not a concern of

[309] Marathon_003142 at slide 3.

[310] Merrill Dep. Tr. 149:10-13 ("'Their' is the point. They're talking, I'm sure -- I'm going to speculate, but I'll leave it up to you what 'their forward planning' means because here Ramsey is talking to his manager.")

exploration. I'm saying that exploration recognized there was a risk element to this project with north-south faulting. That's what the data says and that's what these statements say."[311]

314. Mr. Ramsey's email explicitly acknowledges the risk of faulting, saying that it "would represent the largest element to appropriately appraising this project."[312] Mr. Ramsey testified that, from an Exploration perspective, compartmentalization would add complexity to how many wells would need to be drilled to fully understand the oil in place for the field.[313] Exploration's goals were to "appraise the opportunity" and "de-risk certain subsurface components," whereas Development's concern is to prove a minimum economic field size.[314] Others provided similar testimony. For instance, Ms. Frye also testified about the different objectives between Exploration and Development and how these contributed to differing viewpoint – "[E]xploration goals were around finding new resources" and Development goals were around "production, reserves, and ensuring that we're following internal processes."[315] In her testimony, Ms. Frye also noted that her concerns about faulting related to the impact they could have on the development plan, and that it was the Development team's job to make that plan based upon the data available.[316]

315. The evidence discussed in this report is clear that Anadarko Exploration appreciated the possibility of north-south faulting, but as noted in the same exchange, struggled with achieving a clear consensus internally and externally concerning where to position such potential faults and

[311] Merrill Dep. Tr. 148:6-10.

[312] APC-00117318.

[313] Ramsey Dep. Tr. 101:15-24.

[314] *Id.* 66:2–24.

[315] Frye Dep. Tr. 139:1-17.

[316] *Id.* 71:8-17.

to understand the possible range of impact. Exploration was first concerned with ensuring that the areal limits of the trapped hydrocarbons (up-dip, downdip OWC, east and west extents) were properly represented for a better understanding of "Oil in Place."

316. **Merrill ¶ 60:** "The same day, Browning wrote to McGrievy that 'it would be a huge mistake to go to project sanctioning assuming that our largest mapped fault block, (S3), has the same oil-water contact as the S2 fault block.'"

317. **Rebuttal to Merrill ¶ 60:** Mr. Browning's suggestion is referencing his concern that if Shen-3 encounters downdip wet sands, that additional appraisal of the area up-dip of Shen-3 will be necessary since that area represents a large portion of the prospective STOOIP and extrapolating the OWC from Shen-2 alone would not be sufficient for sanctioning. He is expressing his concern about the Shen-3 well not being drilled further up-dip on structure.

318. **Merrill ¶ 61:** "Nevertheless, Anadarko exploration management continued to *require* the use of a simple, unfaulted, laterally continuous structural model. Despite evidence of faulting, adherence to a best-case scenario led to highly optimistic public statements that exaggerated the likelihood of successful development, resource size, and value. No later than August 2014, the pre-development personnel on Shen objected to the 'no-fault' model used by exploration and identified evidence of a fault in Shen-2. My experience exploring the Gulf of Mexico leads me to conclude that the development team's structural interpretation of Shen, with faults, was more credible than the exploration team's homoclinal structure interpretation. Their interpretation was confirmed as subsequent wells intersected faults showing associated fault compartmentalization. In 2014, Leyendecker criticized the development team's maps. Even in his deposition, Leyendecker admitted he did not include seismic data in his review of the alternative maps, and thus his review was incomplete."

319. **Rebuttal to Merrill ¶ 61:** Merrill has shown no evidence that Anadarko Exploration management "required" the use of unfaulted maps. On the contrary, the evidence indicates that Anadarko management stressed that there should be a single interpretation that represents the appraisal team's official view of the data and that this map would be updated with verifiable data as that data became available and an interpretive consensus was reached. By late 2014, with improved seismic imaging, a growing internal and external consensus, and with Shen-3 data available, Anadarko's Exploration team did start adding faults to their maps. Verifiable faulting continued to be added to their maps throughout the appraisal program as more data became available.[317]

320. Merrill criticizes Mr. Leyendecker for critiquing the Development team's maps when he had not reviewed the seismic data himself, but then proceeds to do the same thing – criticizing the Exploration team's maps without having viewed the seismic data himself. Merrill states that his "experience exploring the Gulf of Mexico leads [him] to conclude that the development team's structural interpretation of Shen, with faults, was more credible than the Exploration team's homoclinal structure interpretation."[318] However, the Development team's maps also changed significantly over the course of the appraisal program, which makes their pre-Shen-3 maps just as interpretive as any other reasonable map. Putting faults incorrectly on a map can be just as misleading and detrimental to project success as not putting faults on a map. When Merrill states that Development's "interpretation was confirmed as subsequent wells intersected faults" he neglects to note that the faults that were intersected were not the faults that were on

[317] Marathon_011477 at slides 12-15.

[318] Expert Report of Robert Merrill, ¶ 61.

Development team's earlier maps and that other faults that were not previously interpreted were later added.[319]

321. **Merrill ¶ 62:** "Figure 13 shows the change in mapping between the completion of Shen-1 and Shen-3. After drilling Shen-2, the development team mapped faults throughout the Shen prospect, including a fault separating the Shen-2 (WR-51#2) fault block and the eastern fault block containing Shen-1 (WR52 #1) and Shen3 (WR52 #2) wells (Figure 11)."

322. **Rebuttal to Merrill ¶ 62:** The maps Merrill cites are both Anadarko Exploration maps and do not show the faults mapped by Development team "throughout the Shen prospect." Development did start placing faults on their maps before and after Shen-3 was drilled, including a fault between Shen-1 and Shen-3, and one between Shen-2 and Shen-3, but many of these faults were eventually eliminated or proven to be incorrectly located. What the Exploration maps do indicate, however, is that the Exploration team did recognize and place faults on their maps as the data and partner consensus matured.[320] For example, the north-south fault on the lower of the referenced maps is post-Shen-3 and shows between 150 feet to 250 feet of offset between Shen-2 and Shen-3, and was used for planning the location of the Shen-4 well.

323. **Merrill ¶ 63:** "Anadarko had four partners in Shen: Cobalt, ConocoPhillips, Marathon, and Venari. Partners can function as project peer reviewers and provide a sounding board for scientific ideas. This is in addition to internal peer review, which the 'Quality Assurance Team' often facilitates, or in this case, the RCT. As to Shen, Anadarko's exploration team ignored the development team's concerns and partner interpretations."

---

[319] Compare APC-00117313 at slide 3 (pre Shen-3) with APC-00029360 at slide 10 (post Shen-3).

[320] *See, e.g,* Marathon_004981 at slide 41.

324. **Rebuttal to Merrill ¶ 63:** Merrill's statement that "Anadarko's exploration team ignored the development team's concerns and partner interpretations" is untrue. There were regular technical meetings between the partners where interpretations were shared and there was additional substantial interaction and exchanges via email between Anadarko Exploration and their partners. Mr. Leyendecker testified that he reviewed Development's and the partners' maps and was well aware of the differences across them,[321] but that he disagreed with Development's and the partners' technical interpretations.[322] Mr. Leyendecker testified as to his belief that the Development team met with ConocoPhillips without the Exploration team interpreters and some partners, creating friction.[323] This then prompted Mr. Leyendecker to request that the partners meet to discuss their different interpretations.[324] Mr. Leyendecker also testified that he spoke with members from Cobalt, Marathon and Venari and encouraged them to come to their own independent technical interpretations.[325] At this early stage of the appraisal program, not all partners were mapping faults at Shenandoah, and Exploration had the obligation to respect each partner's interpretation. As more data became available and a consensus grew between the partners, Exploration added faulting to their maps. There is no evidence that "Anadarko's exploration team ignored the development team's concerns and partner interpretations" as these were discussed and considered throughout the appraisal program.

325. **Merrill ¶ 64:** "Figure 14A is a schematic cross-section Anadarko presented to the partners at a December 14, 2014, partner meeting. The cross-section line is oriented north-south

[321] *Id.* 231:7-232:25.

[322] *Id.* 239:8-240:20.

[323] *Id.* 228:17-23:18.

[324] *Id.* 251:21-252:2; 252:25-253:7.

[325] *Id.* 248:8-20; 252:17-253:7.

with the Shen-1, Shen-2 and Shen-3 projected onto the cross-section. There is a single fault on the cross-section; that fault separates Shen-1 from the other two wells. The accompanying structure map shows the line of the cross-section. If one connects the three well locations, the cross-section crosses a line of mismatched contours. The contour interval in this map (Figure 14B) is 250 feet. A careful examination of this map indicates as much as two contours difference across the line. That difference represents 500 ft – such a dislocation is a fault. The cross-section should have a second fault between Shen-1 and Shen-2; similarly, the cross-section requires a fault between Shen-2 and Shen-3."

326. The traverse and map that Merrill refers to is as follows:

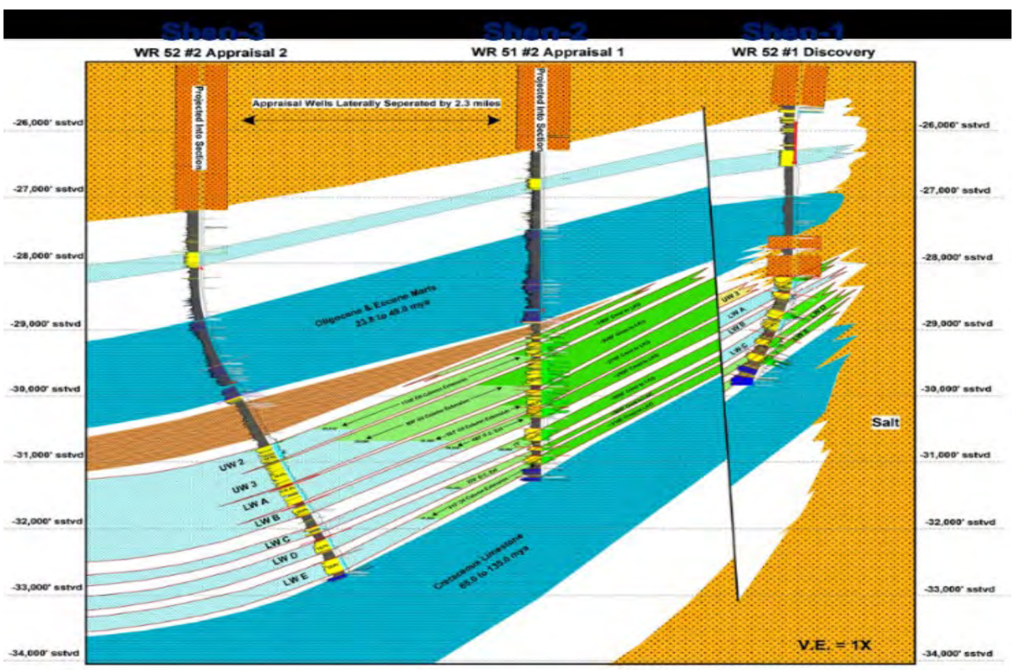


Figure 36 – Referenced north-south traverse through Shen-1, with Shen-2 and Shen-3 wells projected onto it.[326]

[326] APC-00001146 at slide 53.

CONFIDENTIAL

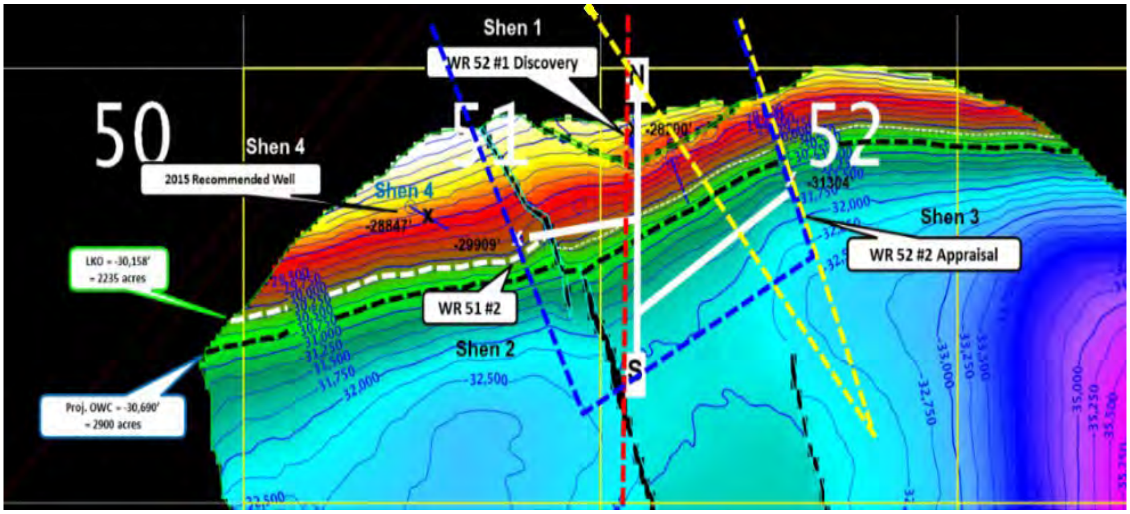


Figure 37 – References map showing north-south traverse as vertical white line labeled N-S. The addition white lines to Shen-2 and Shen-3 show the location (along structural contour) to where these wells would project.[327]

327. **Rebuttal to Merrill ¶ 64:** Merrill erroneously argues that "the cross-section crosses a line of mismatched contours." This is incorrect. The projected wells are placed on the cross section at a location that matches the horizon depth of the north-south traverse. The north-south traverse crosses only the east-west fault south of Shen-1, as shown on the map, and it is shown correctly on the traverse. This north-south traverse does not cross any other interpreted faults. The white lines drawn on the map from the traverse to each well are not parts of the traverse, but only an indication of where each well is to be projected onto the traverse. By inspection, one can see that the contour depth that each well is projected to is the same depth at the well and at the north-south traverse. Mr. Ramsey's testimony that clearly describes the cross section as being on a singular plane through the data further confirms Merrill's error.[328]

328. **Merrill ¶ 65:** "Figure 16 compares Shen structural interpretations from Anadarko and its partners. Figures 15A and 15B, Anadarko maps, compare the 2014 exploration 'no-fault'

[327] *Id.* at slide 54.

[328] Ramsey Dep. Tr. 119:14-17.

map and a development 'faulted' map. A March 2015 PowerPoint prepared for a partner meeting compares partner interpretations of the Shen prospect. Anadarko's map showed a NW-SE fault separating Shen-2 and Shen-3 (Figure 16(A)). ConocoPhillips separated the Shen-1 well from the downdip area with an E-W curvilinear fault and shows radial faults separating five fault blocks (Figure 16(C)). Cobalt separated Shen-1 from the remainder of the field with a curvilinear E-W fault and homoclinal dip south of the fault (Figure 16(D)). The Marathon map showed homoclinal south dip (Figure 16(B)). Interestingly, Marathon recognized the possibility of fault compartments in a map presented in April 2014 (Figure 17). The Venari interpretation before the drilling of Shen-3, indicated radial faulting impacting the prospect and breaks the prospect into five compartments (Figure 16(F)). The radial faults on the Venari map most closely resemble expected faulting against a salt dome or feeder. Finally, curvilinear faults suggest compression from the north rather than extension typical of salt domes. In this case, the curvilinear faults a likely caused by the southward expansion of the salt canopy. Additionally, radial faults align with breaks in the underlying Cretaceous carbonate formation. As early as August 2014, coherency mapping of the Upper Wilcox shows lineaments that are likely faults (Figure 18)."

329. **Rebuttal to Merrill ¶ 65:** As discussed above, these maps support Exploration's conclusion that there was no clear consensus among interpreters on the density, location, type (compressional or extensional), or sealing capacity of faulting. This is a clear demonstration of the uncertainty in interpretation of Shenandoah and a strong reason to be conservative in what is entered onto official maps. The "dip attribute map" that Merrill references below shows an overlay of interpreted faults (red) with the coherency of the mapped horizon. There are clearly discrepancies between the dark shaded areas and the interpreted red lines representing faults. Not all dark areas are interpreted as faults and not all faults are represented by dark shaded areas. The

discrepancies become very significant in the northern part of the basin, where the Shenandoah oil is trapped, where the discovery and appraisal wells are located, and where seismic noise makes any unambiguous interpretation difficult. Merrill makes the point that "[a]s early as August 2014, coherency mapping of the Upper Wilcox shows lineaments that are likely faults." However, Shen-3 was spudded well before that date, and north-south faults were included in Exploration's maps after the drilling of Shen-3.

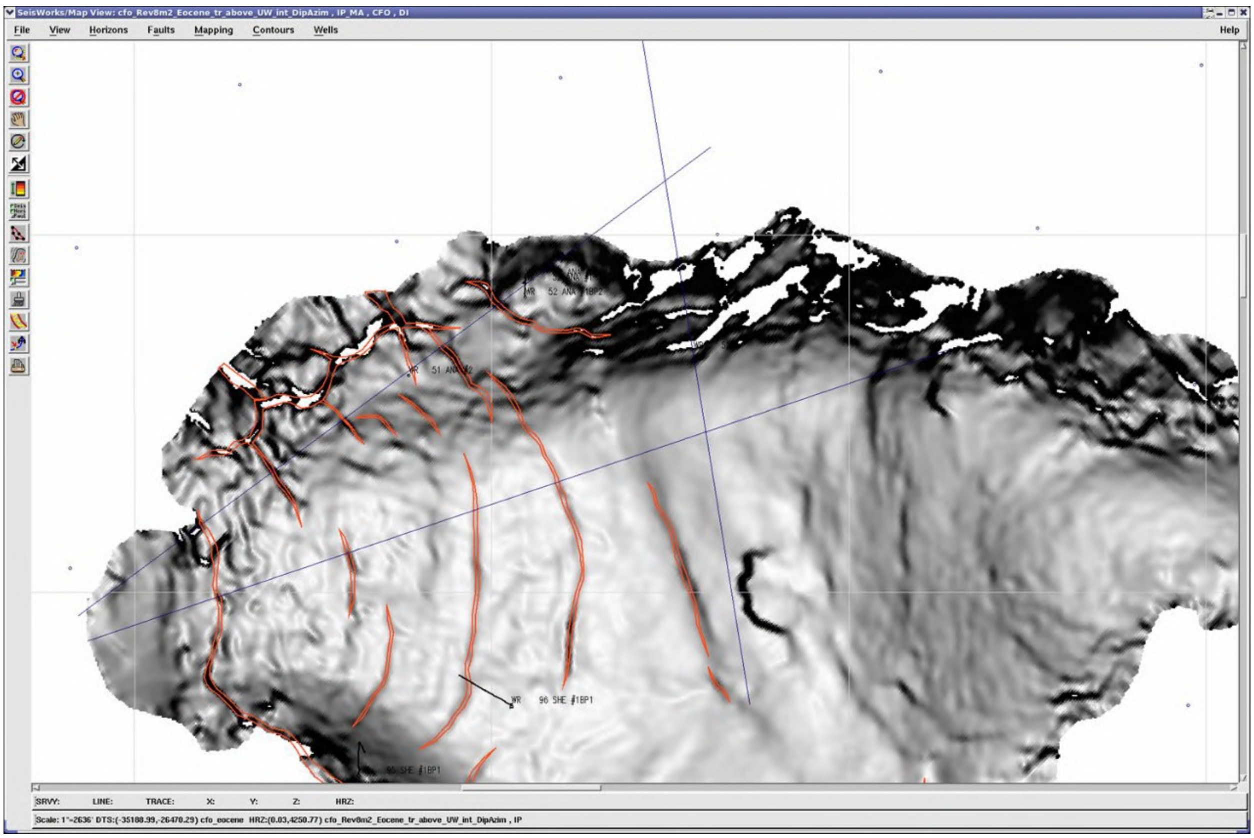


Figure 38 – Anadarko Seismic coherence map (or dip attribute map) created at the top of the Upper Wilcox sand. Note the discordance between mapped faults and mapped shaded areas in the northern part of the map where all appraisal drilling is located.[329]

330. **Merrill ¶ 66:** "Despite evidence presented by partners as well as Anadarko's development group, the Anadarko exploration team continued to use a homoclinal dip map (Figure

[329] APC-00648353 at slide 4.

19) and influenced the 'official' Anadarko position. The public Anadarko resource assessment was based on these maps showing no faults (Figure 19). However, as early as August 2014, the development group used a map with many faults to plan the appraisal and development program (Figure 20). In the September 9, 2015 budget review, the issue of compartmentalization was highlighted by presenting both the exploration 'no-fault' pre-Shen-4 map and the development 2014 map."[330]

331. **Rebuttal to Merrill ¶ 66:** Merrill's statements criticizing Anadarko Exploration's conservative fault interpretations are without merit. Exploration recognized the likelihood of faulting, but there was no confident interpretation about where such faults were to be located. Mr. Strickling's testimony about why there was a lack of significant faulting on Exploration's maps at this point in time confirms this point – "It's not that we don't think there's any faults there, it's just that we just didn't know where they were."[331] Merrill shows an Anadarko Exploration map from November 2014 that was used to illustrate how the Shen-2 and Shen-3 wells projected onto a north-south traverse. Confusingly, he chooses to show a version of the same map that he previously showed in his Figure 14B from December 2014, but the November 2014 map is without the north-south faulting that he now claims is ignored. Also, in November, the Shen-3 well operations (Bypass) had not fully completed and all well data had not yet been assembled.

[330] Expert Report of Robert Merrill, ¶ 66.

[331] Strickling Dep. Tr. 138:21-139:1.

CONFIDENTIAL

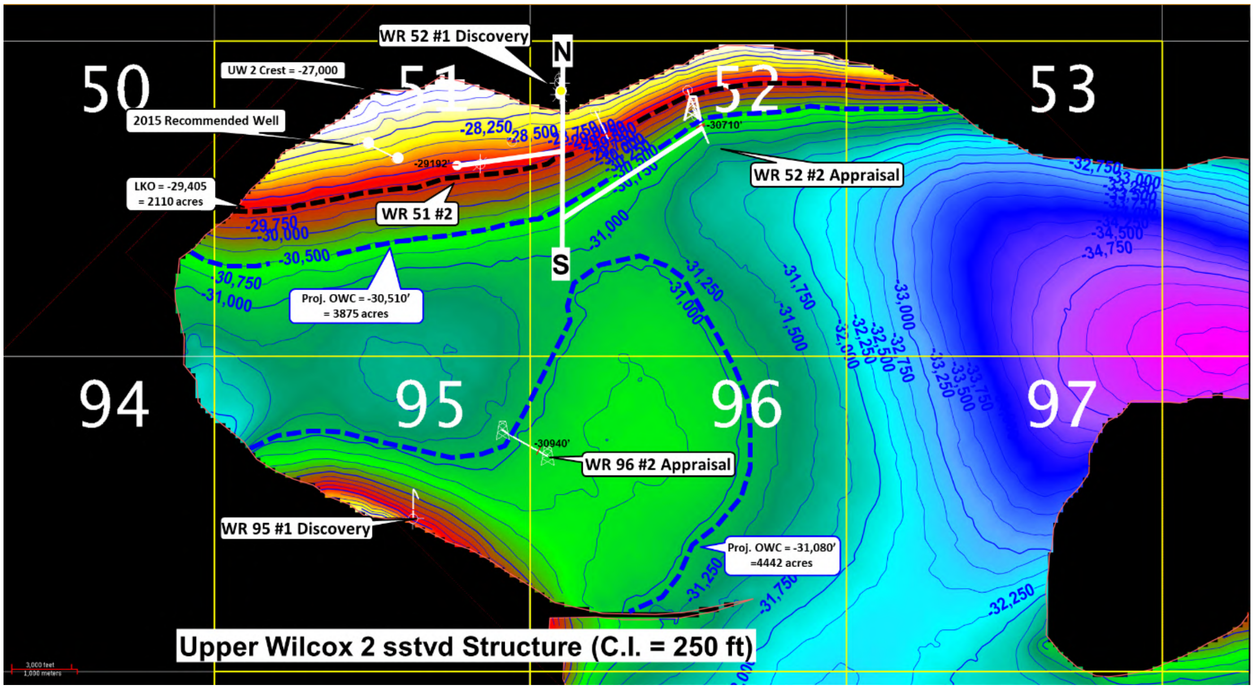


Figure 39 – Anadarko Exploration team Upper Wilcox seismic depth structure map from November 2014.[332] Compare this map with the one he referenced earlier (*see* **Figure 37**, above), which shows the location of the same traverse but with the north-south fault included.

332. Merrill also claims that this November map (without faulting) and not the December map (with faulting) "influenced the 'official' Anadarko position" and that "public Anadarko resource assessment was based on these maps showing no faults" which is wrong or at least, Merrill fails to explain why this map "influenced the 'official' Anadarko position," but the December one (with faulting) somehow did not. Anadarko's updated resource assessments after each appraisal well included the most updated maps and latest well data. After Shen-3 completed drilling and its data was assembled, Anadarko Exploration had included faulting in their maps.[333] However, the impact of that fault on recoverable volumes was still not conclusively agreed upon, either within Anadarko, or among the partners.

[332] APC-00148608 at slide 1.

[333] Marathon_011477 at -489.

333. **Merrill ¶ 67:** "In January 2014, Lea Frye, a reservoir engineer, moved from the Eastern Gulf of Mexico development group to lead the Shen pre-development group. Her assignment was to evaluate development scenarios incorporating resource size and recovery uncertainty to maximize the value of the Shen discovery. Ms. Frye played a key role in the evaluation of Shen. Her professional concern about the differences between Anadarko's public announcements regarding Shen and what was known internally led to a 'whistleblower' complaint to the Securities and Exchange Commission in Spring 2016."

334. **Rebuttal to Merrill ¶ 67:** Merrill mischaracterizes Ms. Frye's assignment. I am not aware of any support that she was assigned to "lead the Shen pre-development group." Rather, Ms. Frye was a reservoir engineer that supported the Anadarko appraisal effort by performing scoping economics that could help identify key uncertainties and reduce cycle time to getting to potential FID.

335. **Merrill ¶ 68:** "The development team identified the risk of faulting early on. A new seismic interpretation called a 'dip attribute' map (Figure 20) coupled with core and well log data, began to clearly demonstrate the risk of reservoir compartmentalization. Figure 17 documents that partner Marathon recognized the risk of compartmentalization as early as April 2014. Despite partner interpretations containing faults and fault compartments in the seismic data and internal, development team interpretations, Figure 19 shows that the exploration team ignored the risk of faulting and fault compartmentalization. However, Anadarko continued to use resource estimate results in their public statements attributed to a single map showing a homoclinal, south-dipping structure with an up-dip trap against salt."

336. **Rebuttal to Merrill ¶ 68:** This paragraph simply repeats Merrill's references to early indications of potential faulting at Shenandoah. However, his statement "that the exploration

team ignored the risk of faulting and fault compartmentalization" based upon a November 2015 Exploration map that was superseded a matter of weeks later is not supported by the record. The record shows that Exploration was aware of the risk of faulting, that they considered it and the range of uncertainties associated with it, and that they included faults in their interpretations explicitly when the data supported a level of confidence in doing so.

337. **Merrill ¶ 69:** "Shortly after being assigned to the Shen project, Lea Frye presented economics for a two-spar development scenario in which she described the 'Remaining Uncertainty and Impact.' Anadarko management adhered to the exploration interpretation for much of the class period, ignoring the uncertainties and impacts listed in the presentation slide (Figure 21)."

338. **Rebuttal to Merrill ¶ 69:** The "uncertainties" on the February 2014 slide that Merrill refers to include "Depositional Environment," "Porosity and permeability trend," and "Seismic Imaging."[334] These were all widely recognized uncertainties; indeed, these same uncertainties appear as information objectives to many of the subsequent appraisal wells. Merrill does not provide any evidence that Anadarko management was "adher[ing] to the exploration interpretation" or "ignoring the uncertainties and impacts" that Ms. Frye listed. Ms. Frye testified that at the time this presentation was created – the presentation that contained "remaining uncertaint[ies]" – her calculations showed that Shenandoah was nonetheless still economic.[335] Moreover, the majority of all economic calculations made for Shenandoah during the class period were subsequently done by Ms. Frye.

[334] APC-01674681 at slide 9.

[335] Frye Dep. Tr. 152:10-13.

339. **Merrill ¶ 70:** "Before the February 19, 2014 meeting, an email chain dated February 18, 2014, between David Blakeley, Manager, Gulf of Mexico Engineering, and Robert Strickling, reservoir engineer supporting exploration, illustrates the beginning of efforts to suppress more conservative data interpretations."

340. **Rebuttal to Merrill ¶ 70:** While Merrill suggests that Exploration suppressed the Development team's conservative opinions that reflected poorly on the project and that there were "efforts to suppress more conservative data interpretations," Mr. Blakeley explained in his deposition that Mr. Strickling was telling Ms. Frye that she should "present just the economics" from the *Development team* and not the assumptions which had not been widely discussed.[336] The documented instances of Exploration requests to limit what data is shown to partners, or to Anadarko Leadership, are principally for reasons related to 1) maintaining consistency in the shared interpretation, 2) demonstrating a single, unambiguous, and confident interpretation, and 3) only exposing an interpretation whose assumptions were noncontroversial and justifiable.

341. **Merrill ¶ 71:** "Exploration continued to insist on a single interpretation with no faulting, while development continued to have serious concerns. Shen-3 was completed in 2014 and encountered no hydrocarbons. In an April 2014 partner meeting, ConocoPhillips recognized lineations at the top of the EO6 horizon (a Wilcox mapping horizon), and the equivalent Anadarko map by Chip Oudin closely approximated ConocoPhillips' map. These lineations were likely related to faults. A May 13, 2015, presentation titled 'Shenandoah Project Overview,' authored by Pat McGrievy, documented seismic interpretation differences between exploration, development, and Anadarko's partners (Figure 22)."

[336] Blakeley Dep. Tr. 73:19-22.

342. **Rebuttal to Merrill ¶ 71:** On this topic, Mr. Oudin has testified that he "didn't have a monopoly on interpretation" and that he did not definitively know whether any of his interpretations were correct.[337] Thus, the fact that both he and ConocoPhillips "recognized lineations" in certain horizons of the field is certainly not definitive proof of their existence, and it likewise fails to support Merrill's claims about Exploration's purported "insist[ence] on a single interpretation."[338]

343. Merrill's conclusion that "Exploration continued to insist on a single interpretation with no faulting" is inconsistent with the maps he presents, since Exploration's map shows north-south faulting separating the field's east and west sides. Merrill also concludes that "the equivalent Anadarko map by Chip Oudin closely approximated ConocoPhillips' map" which it does not. The Anadarko development map has considerably more and differently located faulting, further supporting Exploration's view that it was only appropriate to include mutually agreed upon fault interpretations in the team's official interpretation. Finally, Merrill neglects to note on this picture that Cobalt has interpreted no faulting on the structure, again demonstrating the highly uncertain nature of the interpreted faulting at Shenandoah.

344. **Merrill ¶ 72:** "In my expert opinion, the lack of faulting in the exploration maps should have raised issues. Faulting creates compartments bounded by faults and associated deformation that individual wells must drain. However, a structure with no faulting eliminates the compartments, and larger areas are drained, resulting in an optimistic resource determination. The development team recognized potential faults in 2013, shortly after the completion of Shen-2, which cuts the 'simple' structure into two areas and showed mapped faults (Figure 19). In the

[337] Oudin Dep. Tr. 219:15-220:10.

[338] Expert Report of Robert Merrill, ¶ 71.

Shen-2 well, OBMI (Oil-based Microimager) data suggested a fault existed near the top of the Wilcox, fractures in the Wilcox, and a possible fault near the base of the Wilcox. Paul Chandler was asked in his deposition: '*And it's helpful to look at OBMI data and compare them against seismic data, right?' He testified: 'Yes. The OBMI data, of course, was run in the bore hole of whatever well that they were talking about here. And if you can find breaks in the rock, based on the OBMI data, that corresponds to a seismic interpretation of a fault, then that might give you more confidence that what you are seeing seismically really is a fault and not some seismic artifact.*' The OBMI data were presented in 2013 after completion of the Shen-2 well in March 2013."

345. **Rebuttal to Merrill ¶ 72:** Merrill states "[i]n my expert opinion, the lack of faulting in the Exploration maps should have raised issues" without stating that incorrectly placed faults on Exploration maps would also have raised issues. Exploration recognized the possibility and risk of faulting and chose to put faults on their maps when they could be confidently verified and positioned. Merrill also discussed the OBMI data at Shen-2 where areas of interest were identified. However, as indicated by Mr. Chandler and quoted by Merrill, the value in this data is when one "can find breaks in the rock, based on the OBMI data, that corresponds to a seismic interpretation of a fault."[339] Mr. Chandler testified: "on the OBMI log, it is – it's seldom – it's seldom clearcut. It's always interpreted. It's not – it's not a log that gives you a definite yes, there's a fault, no, there's not. So, there's degrees."[340] Mr. Chandler also testified that OBMI data does not tell you the size of the fault.[341] At the time interval between Shen-2 and Shen-3, none of the

[339] Expert Report of Robert Merrill, ¶ 72 (quoting Chandler Dep. Tr. 86:5-14).

[340] Chandler Dep. Tr. 96:7-11.

[341] *Id.* 85:25-86:3.

partner maps proposed a fault cutting through the Shen-2 reservoir interval that corresponded to these zones identified by the OBMI data.

346. **Merrill ¶ 73:** "There was continuing pressure to have one version of the map in August 2014, as evidenced in an email from Tim Trautman to Pat McGrievy. In November 2014, an email from Patrick McGrievy to Darrell Hollek on the Shen-3 OWC wrote: '*It's hard to go to partner meetings with a straight face and not acknowledge faulting when all of our partners externally share the same concerns.*' In a 'Shenandoah Project Overview' on May 13, 2015, McGrievy clearly documented the development teams' dissent from the exploration team's outdated maps (Figure 19). This dissent was never conveyed to the public. Instead, Anadarko presented overly optimistic interpretations of the Shen discovery without disclosing the dissent based on best practices and the scientific data."

347. **Rebuttal to Merrill ¶ 73:** Merrill draws unsupported conclusions from emails. Merrill confuses Anadarko Exploration's desire to have a single official set of maps with an unsupported inference that faulted maps were censored. Every project that has multiple interpreters with many versions of maps must keep a single official set of maps that represent the most current information. Management asking for only a single set of maps to be shared is common, even if multiple working copies exist among the staff. Mr. Oudin testified supporting this view, stating that this practice related to presenting a united front as operator.[342] As Mr. McGrievy further testified about this very email, he "didn't support [Exploration's] maps because we developed our own, and they in turn, developed their own."[343]

[342] Oudin Dep. Tr. 225:8-226:16.

[343] McGrievy Dep. Tr. 290:6–24.

348. In November 2014, Shen-3 well operations had not yet completed, and Exploration was in the process of updating their maps based upon the new well information. This was a considerable amount of work given that the interpreted depths of all maps in the east were in error compared to the Shen-3 well control, and they needed to be updated. By December 2014, Exploration had updated their maps and had included a north-south fault consistent with one of the faults that ConocoPhillips had interpreted, and similar to a fault that Anadarko's Development team had interpreted.

349. Merrill's characterization of a May 2015 project overview as "dissent" makes little sense. In fact, this characterization appears to misrepresent the timing of events, as it appears to be based upon the Exploration maps from November 2014 discussed above, which had been significantly updated by the time of the Shenandoah project overview Merrill references.

350. As to Merrill's claim that "the dissent was never conveyed to the public," no company would express to the public the range of technical opinions that surround a company project internally. Nor are they required to disclose non-conforming opinions, especially when the uncertainty surrounding the project is the basis for ongoing appraisal activities.

351. **Merrill ¶ 74:** "Mapping shows Shen-2 is in a separate fault block, implying a different pressure regime from Shen-3."

352. **Rebuttal to Merrill ¶ 74:** This is not true unless every sand is disconnected throughout the aquifer, which was not demonstrated or likely since all sands had same water pressure gradient, and none of the mapped faulting separates the downdip aquifer from the up-dip appraisal wells. Mr. Ramsey also testified that the presence of faulting only prevents the projection of OWCs if "both fault blocks do not have access to the same aquifer"[344], and Mr. Ramsey also

[344] Ramsey Dep. Tr. 99:9-13, 18-21.

testified that the areas on the east and west sides of the faults at Shenandoah "definitely [shared] a connection via the aquifer."[345]

353. **Merrill ¶ 74:** "Fault separation of the wells also raises the risk associated with producing the Shen resource. Additional wells are required to drain each compartment of its hydrocarbons."

354. **Rebuttal to Merrill ¶ 74:** This statement is misleading since it is only partially true under certain circumstances. Even with no faulting, a single well can only drain a certain area efficiently, typically less than 600 acres.[346] If the compartments are large, that faulting is of little impact. If the compartments are smaller than one well would efficiently drain, only then are more wells needed. Some very small blocks may not support the cost of a well and be left unproduced. Uncertainty in these issues is typically accounted for if the field's estimated recovery factor.

355. **Merrill ¶ 75:** "One of the reasons [that] exploration justified not mapping faults was due to poor seismic data, but other types of data also evidenced faulting, including OBMI data and MDT pressure data."

356. **Rebuttal to Merrill ¶ 75:** What Merrill neglects to indicate is the evidence of faulting in OBMI data does not provide clear evidence of the offset of a fault nor the lateral and vertical extent of it. OBMI data can only provide an indication of a single area of discontinuity in the well which must be tied directly to seismic mapping in order to be effectively mapped. Likewise, MDT pressures may indicate that two zones are not in communication with each other,

[345] *Id.* 56:21.

[346] High-pressure, deepwater wells commonly produce an average of 10,000 bbls/day over their lifespan, which is typically between 10 and 30 years. Using an average 20 year lifespan and incorporating ~10% of downtime (*i.e.*, periods of no production), one well would recover ~66 MMBOE ((10,000 bbls x 20 years) x 0.9 = ~66 MMBOE.). Assuming that one well produces ~200ft of the hydrocarbon column, 66 MMBOE divided by 200 feet equals roughly 550 acres of drainage area.

but these pressure differences provide no information about where to put a barrier on a map between two wellbores and may not reliably be able to say whether or not areas on either side of a fault with different fluid levels are in downdip pressure communication.

357. **Merrill ¶ 76:** "For example, a partner meeting was held on August 18, 2014, to discuss faults identified by wireline logs, such as dipmeter and Oil-Based Micro Imaging (OBMI) logs. In Shen-1 BP2, four faults were identified with the strongest in the LWC sand, along with 51 fractures. None of these faults were identified in the seismic data. In Shen-2, three faults were identified and '1 fault found at the top of Wilcox (29,006' MD) corresponds to a seismic interpreted fault' along with 6 fractures. These findings are significant because they established early recognition of faulting based on wellbore measurements and that most faults were not apparent in the seismic data but rather, were evident from other data available at the time. In my expert opinion, with seven faults identified in the first two wells, exploration's insistence on an unfaulted structure map directly contradicts this evidence."

358. **Rebuttal to Merrill ¶ 76:** Merrill appears to suggest that evidence of possible faulting in a wellbore requires a fault to be placed on a map. Without an indication of the offset on the fault, its orientation, or vertical or horizontal extent, it would be premature to add the fault to a map without support from seismic data. In addition, there is no direct indication from wellbore measurements as to the sealing capacity of the fault. Exploration recognized that indications of faulting existed in the wells, but chose not to place faults on their map in the absence of clear evidence of where they were located. The fact that these faults could not be identified on the seismic is likely due to the fact that they were smaller in offset than the resolution on the seismic data, which is an indication that they may have been of lower significance. Exploration's early

unfaulted structure maps (pre-Shen-3) were a prudent representation of the information available at that time.

359. **Merrill ¶¶ 77-78:** "As to the MDT pressure data, results from Yucatan-1 and Yucatan-2 MDT pressures shown in Figure 23 below provided information about the potential for faults to seal and cause compartmentalization in the Wilcox. First, Yucatan-1 MDT pressures in the LWA water zone are 180 psi lower than in the overlying oil zone, definitive evidence for an isolating fault intersected by the wellbore. Exploration geologist Ramsey concurred that this pressure shift was fault related. Second, the Yucatan-1 water pressures below the fault are 40-60 psi higher than the pressure gradient established by the water-bearing zones in Yucatan-2, again proving fault compartmentalization laterally between the wells. In my expert opinion, with Yucatan-1 isolated from Yucatan-2 in the water leg, Shen pressures could follow a similar pattern and be isolated from Shen wells. Therefore, trying to establish Shen OWCs from Yucatan-2 pressures was likely unreliable." Merrill then references a cross section that shows the positions of the Yucatan and Shenandoah wells in the basin (see figure below).[347]

[347] Expert Report of Robert Merrill, ¶ 78, Fig. 24.

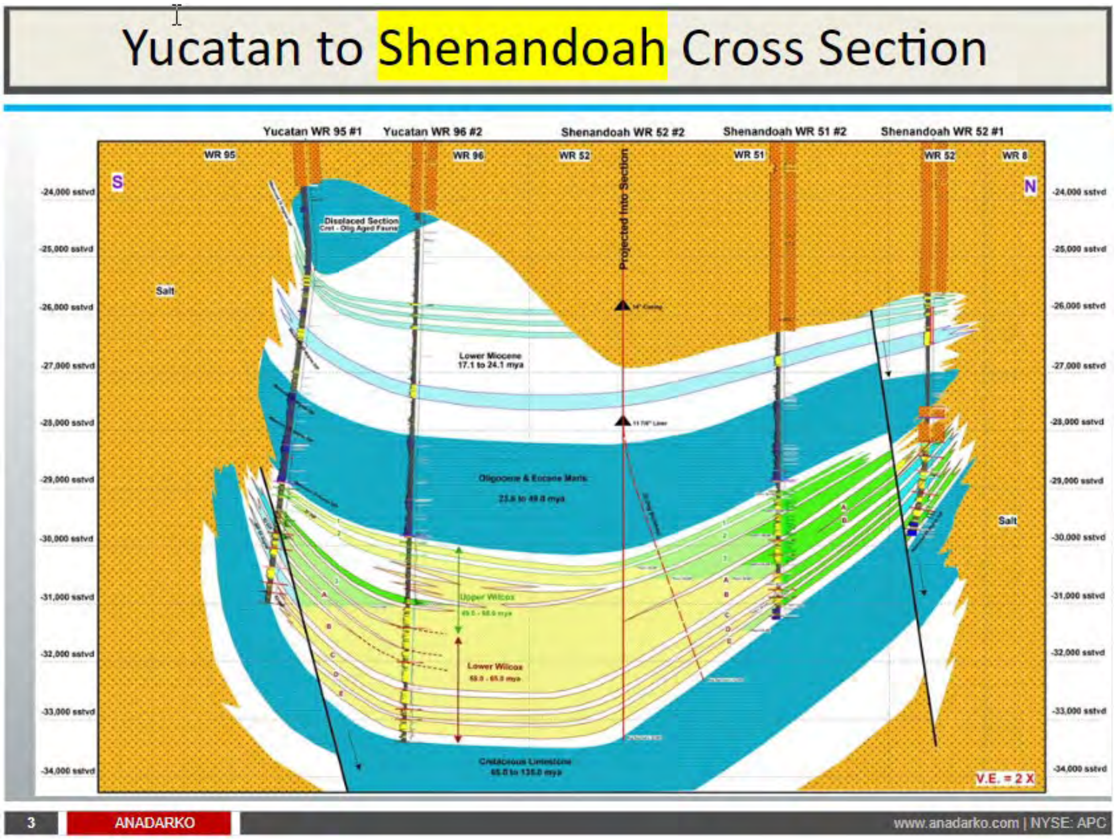


Figure 40 – Yucatan to Shenandoah Cross Section showing the faulting between Yucatan-1 and Yucatan-2 and between Shen-1 and Shen-2.[348]

360. **Rebuttal to Merrill ¶¶ 77-78:** Merrill is correct in noting that the most likely interpretation of the pressures in the Yucatan wells is that they are fault separated from one another. Note that this interpretation can be made because of measured data that defines it. By contrast, there was no data to define the separation of Shen-2 from Shen-3. However, arguing that the structural history that drove the fault separation of the south side of the basin at Yucatan must somehow be analogous to that on the north side of the basin at Shenandoah is an unsupported inferential leap. Relatedly, for the downdip aquifer in Yucatan-2 to be disconnected from the basin center and potentially from the downdip water in the Shenandoah wells would require extensive

[348] APC-00132687 at slide 3.

sealing downdip faults which are not seen in the areas of good seismic or in the pressure data across the basin.[349]

361. Merrill has provided no evidence for his arguments that "Shen pressures could follow a similar pattern and be isolated from Shen wells" and that "trying to establish Shen OWCs from Yucatan-2 pressures was likely unreliable," and has referenced a cross-section that more appropriately supports the opposite conclusion. This cross-section clearly shows the interpreted faults between Yucatan-1 and Yucatan-2, and between Shen-1 and Shen-2. It also shows an unfaulted, connected basin aquifer extending from Yucatan-2 to Shen-3 and to Shen-2.

362. **Merrill ¶ 79:** "In addition, MDT surveys in Shen-1 indicated pressure compartmentalization vertically in the well. The oil samples from each zone varied in measured density and gas content, supporting a degree of vertical compartmentalization. MDT pressures in Shen-2, drilled in 2013, showed that the difference between Shen-1 and Shen-2 pressures in the Wilcox sands was about 180 – 250 psi, suggesting pressure compartmentalization. In Shen-2 (Figure 25), MDT surveys indicated five pressure gradients, and fluid densities in each compartment confirmed vertical stratal unit separation. Such compartments may be stratigraphic. In other words, each sand is sealed by an overlying shale, so there is no vertical communication between sands. Faults also produce similar lateral effects."

363. **Rebuttal to Merrill ¶ 79:** Merrill is correct in noting that "MDT surveys in Shen-1 indicated pressure compartmentalization vertically in the well. The oil samples from each zone varied in measured density and gas content, supporting a degree of vertical compartmentalization." This would be expected given the vertical separation between sands with relatively impermeable shales. This would limit any vertical communication between sands. Merrill also is correct in

[349] *See* **Figure 38**, APC-00648353 at slide 4.

noting that "MDT pressures in Shen-2, drilled in 2013, showed that the difference between Shen-1 and Shen-2 pressures in the Wilcox sands was about 180 – 250 psi, suggesting pressure compartmentalization." This was the part of the basis for the east-west fault/weld interpreted between the two wells. Merrill then also correctly notes that in Shen-2 "MDT surveys indicated five pressure gradients, and fluid densities in each compartment confirmed vertical stratal unit separation. Such compartments may be stratigraphic. In other words, each sand is sealed by an overlying shale, so there is no vertical communication between sands." However, after making these valid arguments and interpretations consistent with the Anadarko and partner teams, Merrill states "[f]aults also produce similar lateral effects," which is possible but highly contrary to the arguments that he just made and the bulk of data available at the time.

5. Rebuttal to Pittinger Opinions re: Shen-2

a. *Rebuttal to Pittinger Opinions re: "The Impact of Faulting: Pre Shen-3"*

364. **Pittinger ¶ 30:** "An email from Dan Bradley with COP to Lea Frye demonstrated the importance that these uniquely [sic] AOPs) had on lowering recovery by as much as one-third. The reduction in recovery resulted from raising flowing pressures to prevent asphaltene deposition in the reservoir.

> 'The AOPs were higher than anything we had seen before and we're trying to understand the implications.'
>
> 'Yesterday, I ran a test case in which I switched from THP control to BHP control, to ensure that the FBHPs remain above 15,000 psi. As you would guess, the rates fall off much faster and I lost about a third of the recovery. We've been setting up an in-house water injection study, because we too see the potential for augmenting recovery. Now, however, **I'm wondering if water injection needs to become the base case assumption in order to protect us from asphaltene precipitation in the reservoir**. Thus, our understanding of the new data and where it is driving us is really important to us right now as we work through the forecasting and economics to support the well AFE.'" (emphasis supplied by Pittinger)

365. **Rebuttal to Pittinger ¶ 30:** At this stage in the appraisal, the impact that asphaltene precipitation might have on recovery estimates was far from understood. For example, when Ms. Frye was asked about whether "asphaltene was a drag on the economics for Shenandoah", she testified that asphaltene was "identified as one of the potential risk factors [that Anadarko] needed to understand better at the time with additional analysis of fluids."[350] Moreover, the email upon which Pittinger bases this assertion indicates that Mr. Bradley's assessment was made by simply lowering drawdown on the well to keep pressures high in the production equipment. It made no attempt to consider mitigation strategies or optimum production engineering designs, let alone their costs.

366. **Pittinger ¶ 31:** "The potential for north-south faulting impacted the uncertainty in resource size because the Shen structure is highly elongated along an east-west axis. With sealing north-south faulting, each potential fault block would need to be tested, and extrapolations of oil and aquifer gradients located miles apart would be unreliable in determining the depth of OWCs without sound evidence of pressure continuity between wells."

367. **Rebuttal to Pittinger ¶ 31:** Pittinger's opinion, which relies upon the benefit of hindsight, demonstrates that the risk of faulting remained a significant uncertainty that Anadarko was testing through the appraisal process. Pre-Shen-3 there was very little evidence for any significant north-south faulting, no evidence that any north-south faulting would be sealing, and no evidence that any potential fault block would not share a common downdip aquifer for pressure support. Evidence of north-south faulting came much later once appraisal drilling had significantly proceeded and improved seismic became available. It is true that if these interpreted faults existed and were sealing, the fault blocks would have independent OWCs. However, each block would

[350] Frye Dep. Tr. 60:19-61:1.

not need to be tested for its OWC as the best producing location for each fault block is up-dip and development wells would simply be positioned to drain the largest blocks. Individuals at Anadarko understood this. For instance, Mr. Strickling testified that even if there were faults, that they would not necessarily prevent "you from recovering . . . oil."[351]

368. **Pittinger ¶ 32:** "The presence of east-west faults would be even more detrimental to the feasibility of Shen commerciality for several reasons. With no faulting, the primary direction of aquifer flow would be up-dip from south to north, and permeability barriers running east to west would block or inhibit aquifer support to up-dip producers. Without aquifer support, injection wells would need to be paired with producers in each of the isolated fault blocks targeted to be developed, increasing the number of critical appraisal and development wells. In addition, the presence of east-west faults would invalidate the inference of OWC depths from down-dip wells."

369. **Rebuttal to Pittinger ¶ 32:** Pittinger has presented no evidence of any east-west faulting affecting the Shenandoah field. All mapped and validated faulting, other than the salt weld downdip of Shen-1, trends north-south. In addition, the presence of an east-west fault alone does not ensure a disconnect between downdip aquifer and up-dip oil, as the angle of the fault and the juxtaposition of sands on either side could very well allow for fluid communication across it. There is no evidence that east-west faults exists at Shenandoah, or that such faults would have created a permeability barrier as Pittinger has suggested.

370. **Pittinger ¶ 33:** "Structural maps of Shen showed faulting as early as mid-2012 and into 2013, raising the above-mentioned red flags for the project."

371. **Rebuttal to Pittinger ¶ 33:** The possibility and consequences of faulting were both recognized and understood within Anadarko and its partners not so much as a "red flag" but rather,

[351] Strickling Dep. Tr. 218:10.

as a recognized risk that needed to be better defined. Indeed the likelihood of faulting is an important consideration that Pittinger wholly fails to address, instead assuming that because some early maps showed faulting, it must have existed. As discussed previously in my rebuttal to Merrill's opinions, this flawed analysis also fails to account for the fact that there was no consensus regarding the specific locations that faults should be mapped.

372. **Pittinger ¶ 34:** "A presentation dated March 1, 2013 shows a faulted structural map in Exhibit 4 of the Shen field on the LWA horizon, likely authored by Rodriguez, as he is listed as the geophysicist on the title page. This map predates Shen-2 and is an early version of the Development team's interpretation of the extent of faulting based on the available seismic data. Faults are the white linear features on the LWA structure map."

373. **Rebuttal to Pittinger ¶ 34:** The map Pittinger uses as his Exhibit 4 is highly suspect, showing faults that were later demonstrated not to be located where they are interpreted here. Additionally, Exhibit 4 depicts sediment where salt was later interpreted and proven to be, as well as a reservoir encompassing over 5,700 acres, which was also proven to be incorrect. Every interpreter has "working maps" and "alternative maps," especially so in an area with as much uncertainty as at Shenandoah. There was never any evidence that this map by Mr. Rodriguez was official in any capacity or that it served any purpose other than for as the basis for technical discussion among peers.

374. **Pittinger ¶ 35:** "The Shenandoah Work Group was announced on April 2, 2013, with Blakely [sic] (Exploration) and McGrievy (Development) as co-leaders. This multi-disciplinary team's mission was to identify 'the challenges, opportunities, and solutions needed to fully appraise Shenandoah and move the project toward sanction as quickly and safely as possible.'

The announcement listed various contributing departments, including Exploration and Development, but did not single out Exploration as having a priority role over other groups.

> We would like to assemble a work group to begin preparing for an eventual Shenandoah development. It would consist of stakeholders from Exploration, Development, Drilling/Completions, Facilities, Production, and Land. There are numerous technical and commercial challenges we face in progressing this project that must be addressed. The mission of the team would be to identify and make recommendations on the key decisions that we face in the coming months and develop a work plan for the next 18-24 months that would keep this important project on track for first production within 5 years. We would envision the team identifying the challenges, opportunities, and solutions needed to fully appraise Shenandoah and move the project toward sanction as quickly and safely as possible."

375. **Rebuttal to Pittinger ¶ 35:** As he makes clear in the paragraphs that follow, Pittinger's observation that the announcement "did not single out Exploration as having a priority role" is meant to demonstrate that Exploration held an unwarranted or inappropriate amount of power within the group. There is commonly a division of responsibilities in such situations, with Exploration focusing on the "define" portion of the project (subsurface description), and Development focusing on the "recovery and economic" portion of the project. This is a dynamic Pittinger conveniently ignores, but which is crucially important in understanding the dynamics of the project at this point in time. Early on in a project, there is understandably more emphasis on defining the subsurface, and so naturally more of the responsibilities fall on Exploration. Indeed, several individuals testified that Exploration was in charge of the project in the early stages.[352] As an appraisal nears completion, the transition from Exploration to Development becomes more

[352] Oudin Dep Tr. 57: 15 –19 (noting that in 2014 "the predevelopment group [was] not in charge of the project"); Chandler Dep. Tr. 52:4 –9 ("Exploration was – as I had mentioned, was charged with the project up and through the Shenandoah 3 well. So they would basically pick the locations for the additional wells. We would have discussions about it, but it was ultimately their – their charge to do that."); Strickling Dep. Tr. 84:8–15 (noting that in 2014 Shenandoah was "an exploration project, it hasn't been turned over to development at the moment").

focused on the economic and production-planning aspects, and this balance shifts.[353] Additionally, it should be noted that from an internal accounting perspective, at this point in time, the Shenandoah appraisal was Exploration's financial responsibility.[354] As Pittinger himself recognizes, the project shifted to Development's purview around the time of Shen-5.

376. **Pittinger ¶ 36:** "Exploration and Ernie Leyendecker endeavored to stifle Development perspectives on faulting. Evidence for a rift between the Development and Exploration groups regarding faulting appeared as early as October 2013 in an email between Rodriguez and McGrievy. Rodriguez informed McGrievy of a presentation he was to show Exploration regarding his interpretations of faults as follows: *'This is the ppt I plan to show Expl tomorrow am. Slides 1-11 are the updated interpretation. (I added the blue fault in crest – analogue is the Shenandoah discovery FB).'* McGrievy commented that interactions with Ernie Leyendecker may have lacked trust and transparency*: 'Thanks for working this Arnold. This is something that we should share with Darrell next week as well. I don't want Ernie blindsiding him or giving him pre-conceived notions before he's heard it from us.'*

377. **Rebuttal to Pittinger ¶ 36:** Pittinger's only evidence for this opinion is an email exchange between Mr. Rodriguez and Mr. McGrievy.[355] What Pittinger ignores, however, is that Mr. McGrievy testified about this document, explaining that: "I just thought that he [Mr. Hollek] wouldn't be happy if we didn't show him first what our position was."[356] There was no evidence of stifling or censoring faulting from maps or discussion, just a desire for staff to arrive at a single,

353 Chandler Dep. Tr. 49:3–7 ("Q And there was overlap in the development phase of the project? A There was some overlap with the Shenandoah 5 6 and 6. Although at that point, the development team was -- was in charge of the project.").

354 McGrievy Dep. Tr. 44:6-17; Strickling Dep. Tr. 86:17-21.

355 Expert Report of Lyndon Pittinger, ¶ 36.

356 McGrievy Dep. Tr. 51:18-19.

unified view of Shenandoah, and for that unified view to be presented through the correct reporting channels appropriately.

378. **Pittinger ¶ 37:** "The unwillingness of Anadarko Exploration management, including Leyendecker, to acknowledge faulting impacted the location choice for Shen-3 and exaggerated the value of information gained from a well in the water leg. In a faulted model, pressures in the water leg would enable projecting OWC's in that particular fault block only, but the OWC's could not be projected across the entire field as claimed later by Exploration. Rodriguez emailed the Development team '*Here's a couple of snapshots of a quick map I made yesterday. Lots of faults set up by the deep Cretaceous structure, which we need to understand a ton more.*' Exhibit 5 is Rodriguez's structure map being referenced above, showing several north-south faults along with some east-west orthogonal faults. Faults are the white linear features. Lending credence to Rodriguez's interpretation, Browning responds with '*Some of the partners have interpreted similar fault geometries. If your maps is (sic) correct, Appraisal Well #2 may be testing an isolated fault block.*' Browning's comment that the Appraisal Well #2 (Shen-3) location tests an isolated fault block, which if wet, will not provide a common aquifer pressure gradient from which all OWCs can be projected. This early observation was diametrically opposed to many of Exploration's later claims regarding the value of Shen-3 as an appraisal well in projecting OWCs."[357]

379. **Rebuttal to Pittinger ¶ 37:** It is interesting to note the significant differences between the earlier map from Mr. Rodriguez that Pittinger mentions and this map by Mr. Rodriguez, which includes additional data. With such changes, there would not be a high degree of confidence in the location or impact of Mr. Rodriguez's interpreted faults. Whether or not the

---

[357] Expert Report of Lyndon Pittinger, ¶ 37.

north-south faulting was there, the east side would need appraising. Targeting the calculated sealing capacity projection of the potential OWC location was independent of any such north-south faulting, and none of the faults drawn on Mr. Rodriguez's map indicate that they extend to the south far enough to isolate the downdip aquifer into compartments. Browning's comments about not being able to use a "wet well" at Shen-3 for OWC projections was wrong, based upon Mr. Rodriguez's map, and every partner in the Shenandoah partnership concurred and used Shen-3 pressures for projecting OWCs.

380. **Pittinger ¶ 38:** "Exploration's reluctance to map or acknowledge faults was at odds with their pre-Shen-2 recognition that faulting, and compartmentalization were important to the project. For example, the Exploration group recognized the importance of faulting and compartmentalization when preparing the logging program for Shen-2 in early 2013.

> The OBMI dip information will be very valuable toward the project in the following ways:
>
> 1.) Help tie the seismic and actual well picks
>
> 2.) Rule out any major faulting or other compartmentalization that may be related to the Oligocene coming in shallower."

381. **Rebuttal to Pittinger ¶ 38:** Pittinger assumes with no supporting evidence that the Exploration team's decisions were based on a "reluctance to map or acknowledge faults," and then proceeds to cite correspondence among Exploration team members that demonstrates precisely the opposite point. Here, Mr. Ramsey is writing about the potential value of future data gathering efforts specifically with respect to how it might affect their understanding of the structure of the field. The fact is that Exploration always recognized the possibility of faulting but also appreciated that putting misleading and speculative faults on a map would drive the appraisal program in a much more limiting way, with potentially significant consequences.

b. *Rebuttal to Pittinger Opinions re: "The Impact of Faulting: Lead*

Up to Shen-3"

382. **Pittinger ¶ 39:** "Based on my review, strong evidence existed early on that faulting was likely to imperil Shen's economics. The internal data revealed that (1) the pressures from Yucatan 2 indicated that OWC's could not be extrapolated across the field; (2) pressure breaks were indicating compartmentalization; and (3) there was increasing evidence of sealing faults from seismic imaging and the OBMI data. This made Shen more difficult and expensive to appraise, while also portending bad news for recoverable oil and associated economics. In my opinion, the economic analyses incorporating these faulting risks were more accurate given the information available at the time. Of particular note are Lea Frye's February 19 and 24, 2014 Presentations, where she found that the PIR was 0.4, and Doug Shotts' August 19, 2014 presentation, where he concluded that the combination of heavy north-south faulting combined with mild east-west faulting could decrease the recovery factor to just 5% and would reduce overall recovery by -81% for a given volume of oil in place compared to the unfaulted base case. His compartmentalized scenario potentially had a net present value of as low as -$2.5 billion, a massive loss for a mega project, and a PIR of -.35 to -.07. In my expert opinion, these findings would be crucial to any prudent operator appraising a challenging and complex deep-water discovery."

383. **Rebuttal to Pittinger ¶ 39:** Pittinger's view "that faulting was likely to imperil Shen's economics" was not true and was certainly not well described before the drilling of Shen-3. Faulting might impact the economics depending upon the extent, sealing capacity, and density of the faulting, but these were uncertainties that the seismic reprocessing efforts and appraisal program would try to address. His claim that "[t]he internal data revealed that (1) the pressures from Yucatan 2 indicated that OWC's could not be extrapolated across the field" is uncited and not correct. There is no direct evidence that water pressures downdip in Yucatan-2 are not in

pressure connection with one or more parts of the Shenandoah field. And some partners have used the pressures in such a way.

384. While Pittinger states that "economic analyses incorporating these faulting risks were more accurate and truer to the information available at the time," he fails to note that most economic analyses were done by the Development team, and all incorporated the assessed impact of faulting either directly (through choice of development well locations) or indirectly (through lower recovery factors) or both. The presentation that he points to by Ms. Frye includes a PIR of 0.4, which Ms. Frye testified would still make Shenandoah economic.[358] Mr. Shotts's presentation, which was made before Shen-3 was complete, reflects a recognition that faulting could impact recovery. But as Mr. Shotts testified, the extensive north-south faulting in his presentation was not an actual representation of the field.[359] The facts that Pittinger relies upon show only that the uncertainties were still large and the range of economic outcomes were still wide.

385. **Pittinger ¶ 40:** "On February 4, 2014, Hollek instructed McGrievy to prepare economics and sensitivities for Kleckner's VP/CEO offsite. This instruction showed the important role of preparing economic evaluations to inform Anadarko senior management of Shen's economic viability and risks. Another important statement in this email by Hollek is that his *'biggest concern would be number of wells needed if we find we don't have a lot of connectivity.'* In my expert opinion, this statement demonstrates Hollek's early awareness of the downside risks of fault compartmentalization."

[358] Frye Dep. Tr. 152:2-13.

[359] Shotts Dep. Tr. 60:5-13.

386. **Rebuttal to Pittinger ¶ 40:** Pittinger is correct that preparing and presenting economics and sensitivities is an important aspect of any appraisal project, but he vastly overstates the extent to which these to which these issues were unique to Shenandoah. Indeed, Mr. Hollek testified about this email, pointing out that all of Anadarko's projects included risks of faulting and concerns about costs.[360]

387. **Pittinger ¶ 42:** "Brad Browning, one of Anadarko's most senior and well respected reservoir engineers, made several strong assertions about potential low recovery factors, compartmentalization, the viability of pressure maintenance, and the potential for major financial loss in his March 2014 email to McGrievy.

> If we limit ourselves to a FBHP of no less than 13K, the abandonment Pbar will be about 14K which gives 7% EUR in this depletion scenario.
>
> **Compartmentalization could cut your reserve estimates in half again assuming a fixed well count with each well expected to drain 500 acres.**
>
> Furthermore, if there's compartmentalization, water pressure maintenance may not be viable, (and the aquifer certainly will not be effective). In this scenario, **including the cost for injection facilities and injection wells will only sink the project further into the red.**" (emphasis supplied by Pittinger.)

388. **Rebuttal to Pittinger ¶ 42:** Pittinger takes Mr. Browning's concerns out of context. Looking at the first line of Mr. Browning's email, it is clear he is merely setting forth one hypothetical scenario calculation that limits the reservoir drawdown due to lack of asphaltene mitigation measures, and that he assumes "depletion" drive, which assumes no connection to any aquifer. Given the level of uncertainty in each of these technical areas, this is precisely the kind of exercise that appraisal teams are charged with – identifying the key risks and addressing them over the course of the project. Notably, Mr. Browning did not draw any conclusions about whether or

[360] Hollek Dep. Tr. 78:19-79:8 (emphasis added).

not these issues can be resolved; he only knows that they must be addressed. Over the course of the appraisal, these issues are addressed to a greater degree by the Development team.

389. **Pittinger ¶ 45:** "On March 25, 2014, a presentation prepared by Frye for Kleckner advocated for water injection to be included in the base case, as shown in Exhibit 7. The table shows the simulation results discussed above that without pressure support from an aquifer or injection wells, the recovery factor was calculated to be just 7% of oil in place compared to the 20% assumed in the base case with injection wells included in the development plan. These simulation results were apparently based on a material balance model for a laterally continuous reservoir, so the low 7% recovery factor did not include the negative impact of compartmentalization within the reservoir caused by faulting. The presence of sealing faults within the reservoir would reduce recovery further by blocking flow from isolated fault blocks not penetrated by a production well."

390. **Rebuttal to Pittinger ¶ 45:** Pittinger's logic is flawed. If the model was laterally continuous, then, even if blocks are separated by north-south faults, good aquifer support is assured. If poor aquifer support is present, then the assumption of compartmentalization is implicit. As noted by Mr. Browning, this model is for "depletion drive" reservoirs and the implicit assumption of east-west faulting sealing the aquifer from each producer. The negative impact of compartmentalization is included. Additionally, even if faults are sealing today and holding several hundred pounds of pressure differential, there is no guarantee that they will continue to seal under production that induces thousands of pounds of pressure differential. Mr. McGrievy confirmed precisely this point in his deposition, noting that a fault that is "sealing [] initially . . . can break down over time due to pressure depletion."[361]

[361] McGrievy Dep. Tr. 116:22-117:1.

391. **Pittinger ¶¶ 46-57:** Pittinger recounts email exchanges regarding Arnold Rodriguez's early mapping efforts of the Shenandoah field, including comments from Brad Browning and Jake Ramsey regarding the potential importance of fault interpretations as a consideration for future appraisal planning.

392. **Rebuttal to Pittinger ¶¶ 46-57:** Paragraphs 46 through 57 of Pittinger's report are substantively identical to Paragraphs 49 through 60 of Merrill's report. Although there are minor variations, my rebuttal to Merrill's report, at Paragraphs 293 through 317, above, is equally applicable to these paragraphs in Pittinger's report.

393. **Pittinger ¶ 61:** "The final risk registry for Shen placed reservoir continuity in the highest risk score category based on the Development team's input. A meeting was held on July 8, 2014 to review the slide deck in advance of an Executive Committee meeting, establishing that this material was used to inform Anadarko senior management."

394. **Rebuttal to Pittinger ¶ 61:** Mr. McGrievy testified that though these risks had been identified, the register was "not necessarily saying that this is the case."[362] These risks were simply risks that needed to be carried in the register along with the action that was to address them. Each identified "risk" will have an associated range of "consequences" and "actions" that need to be taken to mitigate or make the risk "acceptable." Every risk analysis follows this standard practice. Identifying the risks help ensure that all outcomes have been duly considered. Mr. McGrievy also testified that each identified risk had a mitigation plan associated with it.[363]

395. **Pittinger ¶ 63:** "In Kleckner's October 14, 2022 deposition he testified that Development's work on fault compartmentalization was communicated to and understood by

[362] *Id.* 136:13-17.

[363] *Id.* 277:10-14.

senior management: *Q. And so you also shared with other members of the executive committee the risk of reservoir compartmentalization in the Shenandoah field; correct? A. I think that **risk of compartmentalization was well understood by everybody**.*"[364]

396. **Rebuttal to Pittinger ¶ 63:** As discussed above in my rebuttal to Merrill ¶ 47 and Pittinger ¶ 33, above, Pittinger again demonstrates that potential faulting at Shenandoah was clearly appreciated and understood by Anadarko senior management and staff. Mr. Kleckner's testimony makes it clear that the potential of faulting at Shenandoah and the range of attendant consequences were widely known and fully considered by everyone involved in the project. Indeed, recognizing the uncertainty in the range of impact that faulting could have is one reason why senior management continued to support further appraisal.

397. **Pittinger ¶ 64:** "Chip Oudin joined the Shenandoah Development team in June 2014 as the team's Geophysicist, taking over Arnold Rodriguez's role. In July of that year, he emailed Beth Kendall, Exploration's Geophysicist, regarding his work on interpreting faults quoted as follows:

> Arnold has a few N-S faults that I use as guides for my ongoing interpretation (hint: I'm not finished with my final assessment, but **I'm confident that some kind of faulting is there)**. In the SHEN_DEV_IP project, Arnold has three faults that I would ask you to look at: 001_em_1013_Shen_f6; 002_em_0314_ShnRv8_f6; and 003_em_1013_Shen_ R8_m2_f7. In the same project, I have interpreted cfo_ShenRev8m2_WR52_f6 as a single fault that combines elements of Arnold's 001---f6 and 002---f6 faults into a single, N-S trending, down-to-the-SW fault; I'm not convinced at this point whether it should be one fault or more than one fault. Additionally, while Arnold's 003---f7 fault appears more interpretive than the others, Paul Chandler is convinced that there is a fault cut at the top of the Wilcox in the Shen-2 well, which supports its presence." (emphasis supplied by Pittinger)

[364] Kleckner Dep. Tr. 73:7-12.

398. **Rebuttal to Pittinger ¶ 64:** Pittinger claims that "[t]his email shows Oudin's agreement with Rodriguez and early confidence 'that some kind of faulting is there.'"[365] As he testified in his deposition, Mr. Oudin recognized that he did not "know with any certainty whether [his] interpretation of the data was . . . correct."[366]

399. **Pittinger ¶ 66:** "Meanwhile, results from Yucatan-1 and Yucatan-2 MDT pressures shown in Exhibit 11 provided information about the potential for faults to seal and cause compartmentalization. First, Yucatan-1 MDT pressures in the LWA water zone are 180 psi lower than in the overlying oil zone, definitive evidence for an isolating fault intersected by the wellbore. Exploration geologist Ramsey concurred that this pressure shift was fault related. Second, the Yucatan-1 water pressures below the fault are 40-60 psi higher than the pressure gradient established by the water-bearing zones in Yucatan-2, again proving fault compartmentalization laterally between the wells. In my expert opinion, with Yucatan-1 isolated from Yucatan-2 in the water leg, Shen pressures could follow a similar pattern and be isolated from Shen wells. Therefore, trying to establish Shen OWCs from Yucatan-2 pressures was likely unreliable."

400. **Rebuttal to Pittinger ¶ 66:** Pittinger is correct in noting that the most likely interpretation of the pressures in the Yucatan wells is that they are fault separated. Note that this interpretation can be made because of measured data. By contrast, on the opposite side of the basin there is no data to define the separation of Shen-2 from Shen-3. Arguing that the structural history that drove the fault separation of the south side of the basin at Yucatan was somehow correlatable to that on the north side of the basin at Shenandoah is quite an inferential leap. Additionally, for the downdip aquifer from Yucatan-2 to be disconnected from the basin center and potentially from

---

[365] Expert Report of Lyndon Pittinger, ¶ 65.

[366] Oudin Dep. Tr. 220:7-10.

the downdip water in the Shenandoah wells would require extensive sealing downdip faults which are not seen in the areas of good seismic or in the pressure data across the basin. Moreover, this opinion is inconsistent the expert opinions of Mr. Camden and Ms. Peng, as discussed below.

401. **Pittinger ¶ 67:** Pittinger then references a cross section that shows the positions of the Yucatan and Shenandoah wells in the basin (see figure below):

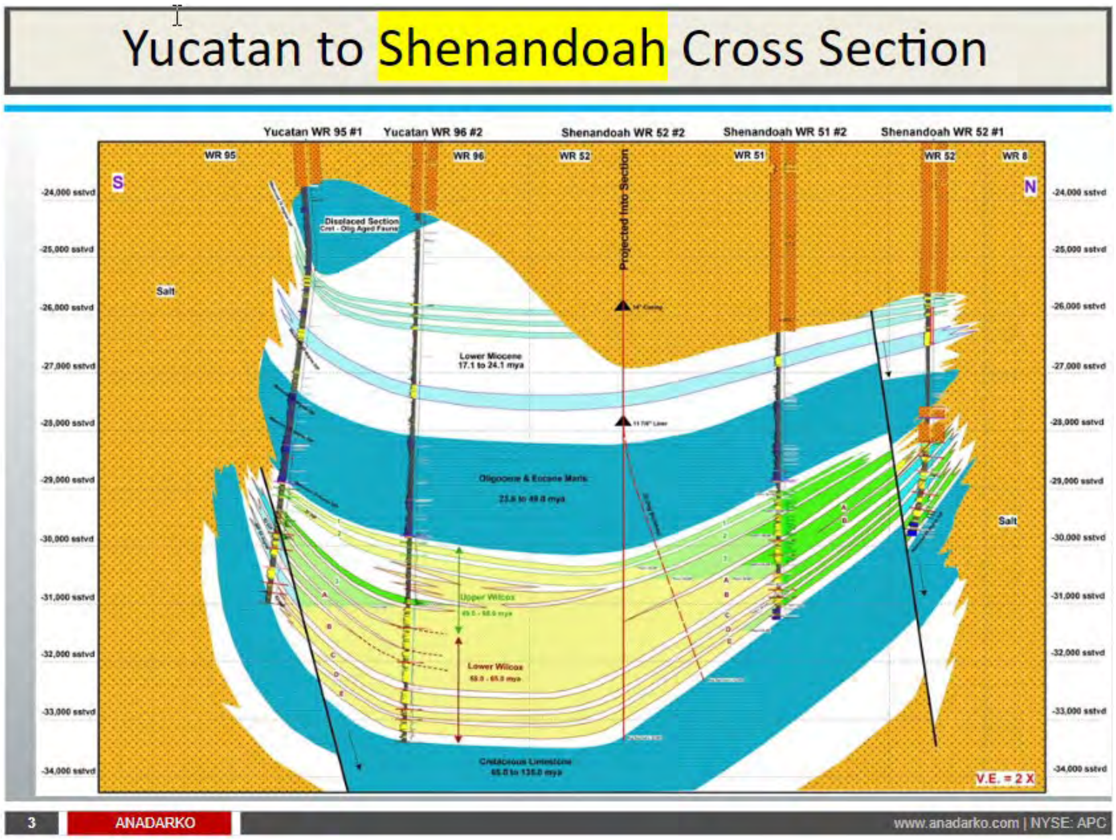


Figure 41 – Yucatan to Shenandoah Cross Section showing the faulting between Yucatan-1 and Yucatan-2 and between Shen-1 and Shen-2.[367]

402. **Rebuttal to Pittinger ¶ 67:** This cross section clearly shows the interpreted faults between Yucatan-1 and Yucatan-2, and between Shen-1 and Shen-2. It also shows an unfaulted, connected basin aquifer extending from Yucatan-2 to Shen-2 and Shen-3. Despite Pittinger's

[367] APC-00132687 at slide 3.

earlier assertion that "Shen pressures could follow a similar pattern and be isolated from Shen wells" and that "establishing Shen OWCs from Yucatan-2 pressures was likely unreliable," he has provided no evidence for these assertions and has referenced a cross section that demonstrates the opposite.[368]

403. **Pittinger ¶ 68:** "A partner meeting was held on August 18, 2014 to discuss faults identified by wireline logs, such as dipmeter and Oil-Based Micro Imaging (OBMI) logs. In Shen-1 BP2, four faults were identified with the most obvious fault in the LWC sand, along with 51 fractures. In Shen-2, three faults were identified and *'1 fault found at the top of Wilcox (29,006' MD) corresponds to a seismic interpreted fault'* along with 6 fractures. These findings are important because they establish early recognition of faulting based on wellbore measurements. In my expert opinion, with seven faults identified in the first two wells, Exploration's insistence on an unfaulted structure map directly contradicts this evidence."

404. **Rebuttal to Pittinger ¶ 68:** Pittinger appears to be suggesting that evidence of potential faulting in a wellbore requires a fault to be placed on a map. Without an indication of the offset on the fault or its orientation, or vertical or horizontal extent, it would be premature to add the fault to a map without seismic support. In addition, there is no direct indication from wellbore measurements as to the sealing capacity of the fault. As discussed above, Exploration recognized that indications of faulting existed in the wells but chose not to place faults on a map in the absence of clear evidence of where they were located. The fact that these faults could not be identified on the seismic is likely due to the fact that they were smaller in offset than the resolution on the seismic data, and if they were too small to be interpreted, then they may be of lower significance.

[368] Expert Report of Lyndon Pittinger, ¶ 66.

Exploration's early unfaulted structure maps (pre-Shen-3 TD) were a prudent representation of the information available at that time.

405. **Pittinger ¶ 69:** "Despite the importance of faulting to Shen's economics and the uncertainty around their locations, Tim Trautman sent an email stating that Anadarko would present only one version of the Shen structure: "*(2). . . Make sure APC is presenting only **one** set of structure maps to partners*." (emphasis supplied by Pittinger)

406. **Rebuttal to Pittinger ¶ 69:** This statement is only significant in that it argues that presenting only a single map/interpretation to partners is important to engender confidence in the operator. Mr. Oudin confirmed this when he testified that Tim Trautman wanted to present only one set of structure maps to partners because it was important to not seem "disorganized" as the operator.[369]

407. **Pittinger ¶ 70:** "Chip Oudin, Development Geophysicist, wrote to Pat McGrievy, the manager of the development group, that he disagreed with the unfaulted tank model:

> I will need guidance on #2, as I disagree with the unfaulted tank model as currently carried by Exploration post-Yuc-2 (see attached). Depending on what's been shown, to whom it's been shown, and when it was shown, we may be stuck (politically) between a rock and a hard place. Especially if interested third parties are involved in any of the basin discoveries. . . ."

408. **Rebuttal to Pittinger ¶ 70:** As discussed above in my responses to Merrill ¶¶ 71, 73, and Pittinger ¶ 64, Mr. Oudin has testified that he "didn't have a monopoly on interpretation,"[370] which was a collaborative process. Thus, his disagreement with the "tank model" is just that; a disagreement. Mr. Oudin testified regarding this particular email[371] that

---

[369] Oudin Dep. Tr. 225:18-22.

[370] Oudin Dep. Tr. 220:1-2.

[371] APC-00011004 at -004.

despite his disagreement with Exploration's map, "present[ing] two different versions or interpretations . . . to partners is not the thing you do," and that "going forward with a unified front at this stage with the group or organization that was in charge of the project [*i.e.*, Exploration] was the proper thing to do."[372] Relatedly, it is worth noting that in an unfaulted basin with multiple discoveries, production decisions in one field can have adverse impacts on other fields in which other companies have ownership interests. Such a dynamic can significantly complicate development planning, and require information sharing with competitors that would otherwise be disfavored.

409. **Pittinger ¶ 73:** "Other presentations showed how faulting would negatively impact recovery. Doug Shotts presented such results in Exhibit 14 from his reservoir simulation study dated August 19, 2014. The recovery factor in the unfaulted Base Case was 26% of oil in place. With heavy north-south faulting, the recovery factor decreased to 15%. With the addition of mild east-west faulting to mild north-south faulting, the recovery factor fell to just 5%, which would reduce recovery by -81% for a given volume of oil in place compared to the unfaulted Base Case. This finding would be crucial to any prudent operator appraising a challenging and complex deep-water discovery."

410. **Rebuttal to Pittinger ¶ 73:** As discussed above, Mr. Shotts's reservoir simulations leveraged artificial (*i.e.*, nonexistent) faults for purposes of demonstrating possible outcomes, and thus describing the results of one such artificial simulation as a "finding" that would be "crucial to any prudent operator" as Pittinger does here, is highly misleading.

411. **Pittinger ¶ 75:** "Shotts' summary states . . . that a highly connected model yields simplistic and overly optimistic recovery estimates. With predominately north-south faulting,

[372] Oudin Dep. Tr. 91:7-12.

effective pressure support can still occur between up-dip producers and down-dip injectors or aquifers. However, each isolated block would require a producer and an injector to achieve the assumed recovery efficiency, raising the potential well count. East-west faults have a more negative impact by limiting the connectivity between up-dip producers, down-dip injectors, and aquifers. Therefore, each isolated fault block would require its pair of production and injection wells. Relatively poor seismic imaging below salt at this depth makes it extremely unlikely that all of the barriers isolating the fault blocks could be identified before development plans are made and production begins. As a result, barriers to flow become much more evident as production depletes reservoir pressure. He provided the following advice for avoiding an economic train wreck: '*An economic train wreck due to uncertainty in subsurface can be avoided through phasing and/or pilots.*'"

412. **Rebuttal to Pittinger ¶ 75:** Pittinger quotes Mr. Shotts in his recommendations for development planning to mitigate the uncertainties with respect to faulting in the subsurface as saying that "[a]n economic train wreck due to uncertainty in subsurface can be avoided through phasing and/or pilots."[373] Pittinger misrepresents this comment as a negative observation about the overall commercial viability of the field. Quite the opposite, as Mr. Shotts testified, this was simply an observation that a key factor in creating a successful development plan is in ensuring proportionality; the size of the development concept should align with the size of the resource. Where uncertainty is high, it can be desirable at first to test certain areas or recovery techniques on a smaller scale, gradually broadening scope as more is understood about the resource. [374] In fact, a phased approach to the development of Shenandoah like the one Mr. Shotts describes was

[373] APC-00001974 pp. 86-87.

[374] Shotts Dep. Tr. 79:18-80:18.

one of the options that Anadarko's development team considered in evaluating possible development scenarios.[375]

413. **Pittinger ¶ 78:** "Oudin prepared a file showing that all partners – Marathon, COPC, Cobalt, Venari, and Anadarko operations – considered the chance of east-west faulting significant enough to include in their structural scenarios. However, Anadarko Exploration was alone in its support of a single overly simplistic unfaulted structural model, as shown in Exhibit 16 below:"

Figure 42 – Pittinger's Exhibit 16: Partner Structural Interpretations (Oudin 8/20/14).[376]

414. **Rebuttal to Pittinger ¶ 78:** It is apparent from this summary that the fault mapping by different interpreters suffers from uncertainty and lack of agreement on where to place any such faults. This is the reasoning for Anadarko Exploration to avoid locating speculative faults on official maps that will drive the appraisal program until data and consensus supported such an interpretation.[377]

415. **Pittinger ¶ 79:** "On the same day, Oudin prepared another file with the following slide in Exhibit 17 showing distinct north-south trending lineaments highlighted with dashed lines

[375] *E.g.*, APC-00617572 at -572.

[376] APC-00011019 at slide 3.

[377] *See, e.g.*, Marathon_004981 at slide 41.

mapped on the Upper Wilcox. He includes a note written with sarcasm dismissing the importance of faults: '*Don't worry, these lineaments are not faults and in no way impact the Shenandoah structure.*'"[378]

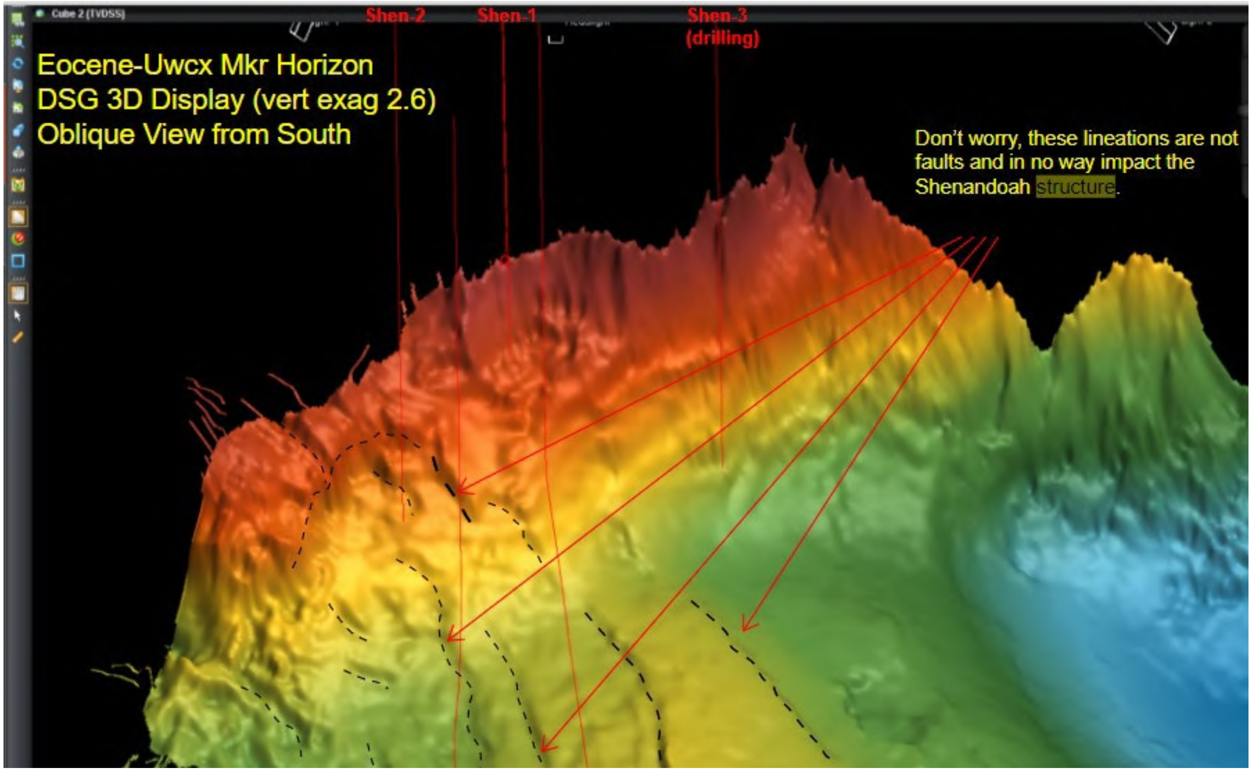


Figure 43 – Pittinger's Exhibit 17: Structure Map with Lineaments (Oudin 8/20/14).[379]

416. **Rebuttal to Pittinger ¶ 79:** It is also important to note that these lineaments shown on Mr. Oudin's map are located substantially downdip of any oil accumulation or appraisal drilling at Shenandoah and that their possible extension to the north, up-dip, would be very speculative, and any potential impact of these basin-centric lineaments on the drilling of Shen-3 would be

[378] Expert Report of Lyndon Pittinger, ¶ 79.

[379] APC-00011019 at slide 8.

negligible. Mr. Oudin testified about this and indicated that this was a "spoof" presentation, and that he was being sarcastic because Exploration was sticking to their interpretation.[380]

417. **Pittinger ¶ 81:** "Frye informed Shotts in an email dated August 22, 2014 that his presentation would have to be edited to remove references to faulting to comply with directives from Exploration. In my expert opinion, these editing changes showed Exploration management censoring technical work on the most important risk impacting the Shen project, which was described as a mega project for Anadarko in APC-00007950 dated June 18, 2014, as discussed above:

> 'Doug, Based on the dialog/politics between exploration and development we have removed all references to faults and I desensitized the verbiage to remove any word that says "fault" and made the language barriers/compartmentalization.'"

418. **Rebuttal to Pittinger ¶ 81:** Pittinger offers no citation or evidence demonstrating any directives from Exploration, and I could find no evidence for any such directives. This email that Pittinger references indicates that Frye herself took the initiative to remove these references to "faults" and replace them with "barriers/compartmentalization." The term "fault" was reserved in exploration for geologically mappable events, in contrast with "barriers and baffles," which were deemed more appropriate for more speculative indications of discontinuities. There is no evidence of "censoring" of technical work by any Anadarko staff and Pittinger's claims of such are unsubstantiated. As discussed in more detail above, Mr. Shotts's work was shown to partners on multiple occasions and was not "censored" by Anadarko management.

419. **Pittinger ¶ 83:** "The importance of addressing the issue of faulting was made very clear by Shotts' economic analysis of the compartmentalization case shown in Exhibit 19 below.

[380] Oudin Dep. Tr. 103:1-105:6.

His compartmentalized scenario potentially had a net present value of as low as -$2.5 billion, a massive loss for a mega project. In my expert opinion, Exploration elected to disregard the risk of compartmentalization and chose instead to censor the use of the word 'fault.' This information was one of the most important pieces of information on the commercial viability of the Shen project, one of Anadarko's most important projects. This information was seen by management in a budget presentation to the Integrated Project Team ('IPT') on August 28, 2014."

420. **Rebuttal to Pittinger ¶ 83:** Pittinger attempts to conflate use of the word "fault" with censorship of technical analysis involving compartmentalization. As discussed in the preceding paragraph, the choice to use the word fault to describe observed, geologic barriers within a reservoir simply does not equate to censorship of technical analysis. As discussed above, none of the technical analysis Pittinger claims was withheld from the partners was in fact withheld. Pittinger's opinion is essentially that the word "fault" was "one of the most important pieces of information" relating to Shenandoah's commercial viability.[381] Moreover, Pittinger undercuts his own argument by pointing out that, in fact, the team had taken steps to address faulting in their economic analysis.

c. *Rebuttal to Pittinger's Opinions "Appraising the Shenandoah Resource: Pre Shen-3: Exploration Team"*

421. **Pittinger ¶ 179:** "The Exploration group calculated the estimated resource range using software by Rose and Associates, including the Multi-Method Risk Analysis ('MMRA') program and the Multi-Zone Master, both Excel-based software. The MMRA tool calculates a range of resource sizes based on assumptions for the area, net pay, and recovery that are input as probabilistic ranges and combined using the process of Monte Carlo simulation. The Multi-Zone

[381] Expert Report of Lyndon Pittinger, ¶ 83.

Master can then be used to combine different layers or fault blocks. With multiple stacked sands and fault blocks, no single method has been deemed correct or the industry standard in classifying the parts and combining those parts, allowing various approaches to calculate resource volume."

422. **Rebuttal to Pittinger ¶ 179:** Pittinger's admission that there is "no single method [of calculating an MMRA] has been deemed correct or the industry standard" is noteworthy. The key differences in the resource estimates between the Anadarko Exploration and Development teams were the result of different interpreters taking different approaches. This issue becomes especially complex with "stacked" reservoirs and can give rise to significant differences is estimates. This is because certain characteristics and sands have "dependencies" that can be accounted for in different ways. Much of Exploration's treatment of the reservoirs assumes that some intervals are independent, and their probabilistic volumes can be simply added together.

423. **Pittinger ¶¶ 180-186:** Pittinger describes in detail Anadarko's Exploration team's methodology at this point in the appraisal program for estimating volumes using the Rose & Associates MMRA software. "In my expert opinion, the lower end of this distribution did not represent the uncertainty existing at that time, especially considering the poor-quality seismic imaging below the salt. . . . One source of inaccuracy in Exploration's resource range resulting in a large value for P90 is the method of adding several elements together with the assumption of independence between each sampling event. For example, the combined estimate for the Lower Wilcox sands was the sum of five layers A through E being sampled with complete independence from each other. The average resource P10/P90 ratio for each Lower Wilcox sand was 3.6, but the resulting Multi-Zone Master resource range for five zones had a P10/P90 ratio of only 1.84 based on independence between each horizon. Summing independent sampling events results in a substantial reduction in variance depending on the number of sampling events. In contrast, the sum

of fully dependent events tends to preserve the variance. Consequently, the summation process combining elements shown in Appendix B involved 11 total events, all sampled with the assumption of complete independence, causing the P10/P90 ratio to flatten significantly and understate the downside risk. . . . One argument for assuming dependence and not independence between outcomes for each horizon is when multiple layers in a stacked reservoir share a common uncertainty. . . . The extent of the P10 area extends to the spill point shared with the Yucatan discovery. In my expert opinion, this area would be more representative of a P1 maximum than a P10 scenario, making the P10 area overly optimistic."

424. **Rebuttal to Pittinger ¶¶ 180-186:** Anadarko Exploration followed a method that assumed that some intervals are statistically independent of each other, as are some of the individual sands. Calculating volumes this way has a tendency to raise volumetric estimates and "flatten distributions" as volumes are "added" together. This pushes the P10/P90 ratios smaller. The team's estimate is partially a result of their implicit assumptions regarding how they dealt with multi-zones that have the potential for strong dependences on one another.

425. Pittinger critiques the ways Exploration calculated resources and the interpretive choices that Anadarko Exploration made. Each of these critiques represent his expert technical opinion as to his view of "best practices." But, in making these criticisms, Pittinger has taken on the role of a "technical advisor" to the Exploration team, critiquing the technical capability and interpretive choices that they had made. The fact is, as Pittinger had previously noted, "no single method has been deemed correct or the industry standard in classifying the parts and combining those parts, allowing various approaches to calculate resource volume."[382]

[382] Expert Report of Lyndon Pittinger, ¶ 179 (emphasis added).

426. **Pittinger ¶ 187:** "The sum of P90 net pay for all eight sands combined totaled 760 ft. and was more than twice the net pay thickness encountered in Shen-1; the sum of P10 net pay for all zones totaled 1,031 ft., which exceeded the total encountered in Shen-2. In my expert opinion, these P10 and P90 net pay estimates are very optimistic. The estimates do not honor the data given: (1) the P90 assumption for net pay was more than twice the lower result in Shen-1 results; and (2) the P10 estimate exceeded the best Shen-2 result to date. Most of the oil-filled structure lies up-dip of Shen-2, and to having a fieldwide net pay value greater than Shen-2 requires thickening higher in the structure, which is precisely opposite to the existing evidence for crestal thinning discussed above."

427. **Rebuttal to Pittinger ¶ 187:** Pittinger's critique that "P90 net pay for all eight sands combined totaled 760 ft. and was more than twice the net pay thickness encountered in Shen-1; the sum of P10 net pay for all zones totaled 1,031 ft., which exceeded the total encountered in Shen-2" is not valid. Exploration's estimate of P90 net pay is based upon a net sand isopach for each of the Upper Wilcox and Lower Wilcox (see Figures **44** and **45**, below) tied to the Shen-2 well that each thin up-dip, and a (P90) LKO contact limit for defining downdip net pay thickness. Their estimate of P10 net pay is based upon the same isopachs, but with net sands thickening downdip of the Shen-2 well to the P10 estimate of the OWC.

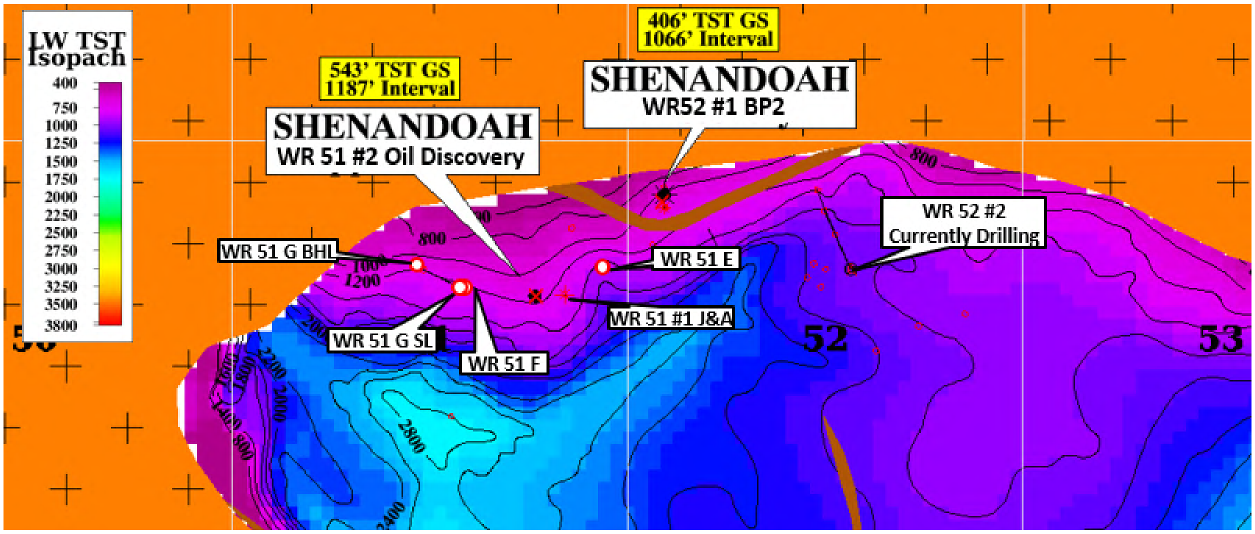


Figure 44 – Anadarko Exploration isopach of Lower Wilcox before drilling of Shen-3 well showing thinning of reservoir sands up-dip.[383]

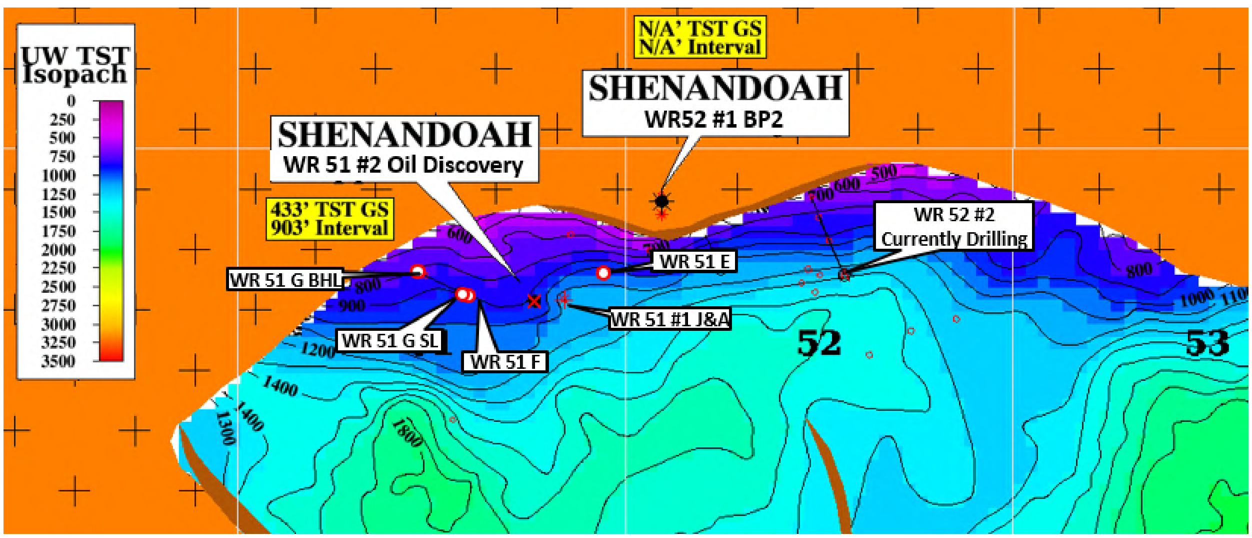


Figure 45 – Anadarko Exploration isopach of Upper Wilcox before drilling of Shen-3 well showing thinning of reservoir sands up-dip.[384]

428. Pittinger's conclusion that "having a fieldwide net pay value greater than Shen-2 requires thickening higher in the structure" is wrong. The extra sand in exploration's estimates

[383] APC-00633951 at slide 1.

[384] *Id.* at slide 2.

comes from downdip and to the east of the Shen-2 well. Again, Exploration's choice of methodology for estimating resources follows a logical, auditable pattern that may or may not be agreed with, but which represents their best interpretive technical work at the time. Pittinger's criticism is of their technical, interpretive choices, but every interpretation is unique.

429. **Pittinger ¶ 188:** "Another source of inaccuracy in Exploration's resource estimate regarded the appropriate recovery factor . . . . This was decidedly over-optimistic."

430. **Rebuttal to Pittinger ¶ 188:** While Pittinger criticizes Exploration's estimates for recovery factor, Exploration's choices were driven by the better rock and fluid quality seen in the Shen-2 well than previously seen in any other Paleogene discoveries, and so they used Miocene analog recoveries for their estimates. Again, this was an interpretive choice. Even Pittinger confirms that recovery factors of ~26% are reasonable when he quotes Mr. Shotts modeling results for an unfaulted Shenandoah model in the following paragraph: "With just north-south sealing faults, the recovery factor dropped to 15%, down from *26% for an unfaulted, laterally continuous model.*"[385]

431. **Pittinger ¶ 189:** "Shotts' August 19, 2014, reservoir modeling study highlighted the potential negative impact of faulting on recovery efficiency considering the high asphaltene onset pressures. With just north-south sealing faults, the recovery factor dropped to 15%, down from 26% for an unfaulted, laterally continuous model. Introducing a moderate number of east-west faults caused the recovery factor to drop down to just 5%. . . . With increased compartmentalization, more wells are needed . . . . The study also provided an economic warning to the organization that compartmentalization could result in unfavorable project economics as shown in Exhibit 46."

[385] Expert Report of Lyndon Pittinger, ¶189 (emphasis added).

432. **Rebuttal to Pittinger ¶ 189:** Again, Mr. Shotts had generated the "scoping study" to investigate the impact of potential discontinuities in the subsurface and to understand "sensitivities" to the unknowns that remained at Shenandoah after the Shen-2 well. His conclusions were that for a fixed reservoir volume, compartmentalization, and pressure support (via aquifer or injection wells) were the most significant impacts to the field's recovery factor. The modeled 5% recovery that Pittinger refers to was arrived at by Mr. Shotts for reservoirs across the Shenandoah field with sealing north-south faults located every 1-mile (denser than the well spacing) and sealing east-west faults also located every 1-mile (eliminating any possible pressure support). Mr. Shotts's "base case" recovery was calculated at 26%, and the 5% recovery was a P1 worst-case scenario. Mr. Shotts described these faults in his testimony as "not based on physical mapping" and "arbitrary in the sense that [they were] just a grid."[386]

d. *Rebuttal to Pittinger's Opinions re: "Appraising the Shenandoah Resource: Pre Shen-3: Development Team"*

433. **Pittinger ¶ 191:** "The Exploration team showed a P50 Case of 949 MMBO and a rate of return of 34%. The Development team showed a deterministic case of 767.5 MMBO, resulting in a 19% rate of return. Exploration's 949 MMBO P50 case (25% recovery factor and 1,000 scf/bbl GOR) was similar to their 1,197 MMBOE discussed earlier when adjusted for the gas equivalence and slightly different recovery factor assumed in the MMRA files. The Development team's resource estimate was smaller primarily due to a lower assumed recovery factor of 20%, compared to Exploration's 25%. The Development team's 19% rate of return was lower due to the 19% lower recoverable resource volume and higher facilities cost of $6.3 billion compared to Exploration's cost of $3.4 billion."

[386] Shotts Dep. Tr. 147:2-5.

434. **Rebuttal to Pittinger ¶ 191:** It is not uncommon for Exploration to be working economics with "scoping numbers" that are intentionally broad and intended to put the team in the ballpark. The uncertainty on economic calculations at this stage of the appraisal have very large uncertainties associated with them, and the intent of these calculations is to identify the key areas where resources need to be focused both in the appraisal drilling and also in the development design and costing. Differences between the two teams help to provide that focus. However, Pittinger's continued comparisons between the Exploration and Development interpreters and teams also demonstrates two important points:

- That different interpreters and different interpretive technical groups can have different but equally valid views of risks and uncertainty, and
- That the Anadarko Exploration and Development teams never chose to work together as "one team" and each provided a valid, but different, interpretation of the subsurface, risks, and uncertainties.

435. **Pittinger ¶ 192:** "The day before this presentation, Blakely [sic] and Strickling, both in Exploration, wrote in an email exchange about Frye's economic evaluation of the Shen project that she would be showing to Kleckner. They expressed concern about her results: 'Lea is coming up with economics with a PIR of < 4 for Shenandoah.' Blakeley then responds with the following: 'Ok. We need to keep from delivering a message to Kleckner that Shenandoah is a marginal project *by being overly conservative on assumptions*.' This exchange establishes that Exploration was concerned about having Development express independent and potentially more conservative project analyses."

436. **Rebuttal to Pittinger ¶ 192:** Pittinger demonstrates the important differences between Exploration and Development when he cites Blakeley's concerns. Following the rest of

the email trail makes it clear that Mr. Blakeley and Mr. Strickling's concerns were about the assumptions that went into the economics and whether or not they had been reviewed and validated. Mr. Blakeley explained in his deposition that in this email, that, in his opinion, Mr. Strickling was telling Ms. Frye that she should "present just the economics" from the development team and not the assumptions which had not been widely discussed.[387] In addition, Mr. Strickling explained in his testimony that he viewed Ms. Frye's economics as overstating capital requirements.[388]

D. Shen-3

1. Well Results

437. After the tremendous success of Shen-2, the Shenandoah partners agreed to drill the next appraisal well— Shen-3, also referred to as WR 52-1—far to the east and down-dip of Shen-1 and Shen-2, into the adjacent lease block, WR 52. Timing for Shen-3 was more accelerated than Shen-2 due to the approaching expiration of Anadarko's leases on the Walker Ridge blocks in May 2014.

438. The documented pre-drill objectives for the Shen-3 appraisal well were:

> "Shenandoah WR 52 #2 Appraisal Criteria:
> 1.) Lateral Stratigraphic Confirmation.
> 2.) Structurally Down-Dip of Shenandoah Appraisal Sand Penetrations by 800 to 900 ft.
> 3.) Remain Within Well Imaged 'Shenandoah' Closure.
> 4.) SPUD before WR52 Lease Expiration (May 31st 2014)"[389]

439. Among other pre-drill objectives, the well was intended to test the oil-water contact in the eastern portion of the field. In other words, a key goal for Shen-3 was to learn more about

[387] Blakeley Dep. Tr. 73:19-22.

[388] Strickling Dep. Tr. 208:1-209:17.

[389] Marathon_014658 at -664.

where the oil stopped and the water began down-dip of Shen-2, which as noted above was "full to base," meaning it did not encounter water.

440. The AFE for the Shen-3 well included a "carry" for Anadarko's well costs that added the north half of OCS block WR53 (which Anadarko held 100%) into the unit and partnership with project interests remaining unchanged.[390] Beyond this point, the Shenandoah unit included OCS blocks WR 51, WR 52, and the north half of WR 53.[391]

441. The Shen-3 well was spud on May 28, 2014, and a bypass core on the well was spud in December 2014.[392] While Shen-3 did not encounter the oil-water contact and found only water-filled sands, it did encounter Upper and Lower Wilcox sands that were approximately 50% thicker in total than those encountered in Shen-2,[393] and pressure data from the well enabled Anadarko to project the oil-water contact as likely being only slightly up-dip of Shen-3. The sands were also stratigraphically "correlated" to the sands that were filled with oil in Shen-2. This strong correlation was based upon the common characteristics, properties, and well log shapes of each sand that defined their simultaneous deposition (*e.g.*, sand grains fining upwards, thick, blocky sand, etc.).[394]

442. Shen-3 encountered the Upper and Lower Wilcox intervals at a greater depth than expected (approximately 1,100-1,450 feet down-dip of Shen-2 as opposed to a projected 700-800 feet down-dip),[395] and pressure data in each sand led some partners to believe that Shen-2 and

[390] ANACOP00000001 at slides 2, 10.

[391] *Id.* at slide 10.

[392] Marathon_014286.

[393] APC-01678462 at slide 5, 10-11.

[394] APC-00001466 at slide 11.

[395] *Id.* at slide 5.

Shen-3 were likely in different fault blocks due to seismic indications that a north-south fault might divide the Shen-2 oil from any up-dip Shen-3 oil.[396] However, by their mapping of a common OWC on either side of the north-south fault, all of the Shenandoah partners interpreted that the two fault blocks were likely in pressure communication through their common downdip aquifer, and that the area east of the mapped north-south fault still contained significant oil up-dip of Shen-3.[397] For example, Marathon noted that "[i]ntegration of MDT data from WR52# 2 with that from WR51#2 provide estimated free-water levels, if we assume pressure communication between the two wells and a single aquifer gradient in WR52#2."[398] Contemporaneous partner comparison summaries confirm that Cobalt,[399] Venari,[400] and Marathon[401] projected oil-water contacts using the same methodology as Anadarko, and that each company generally arrived at similar projections.

[396] *Id.* at slides 51-52.

[397] Marathon_003646 at slide 6.

[398] Marathon_003362 at slide 16.

[399] APC-01681245 at slide 1.

[400] *Id.* at slide 8.

[401] *Id.* at slide 9.

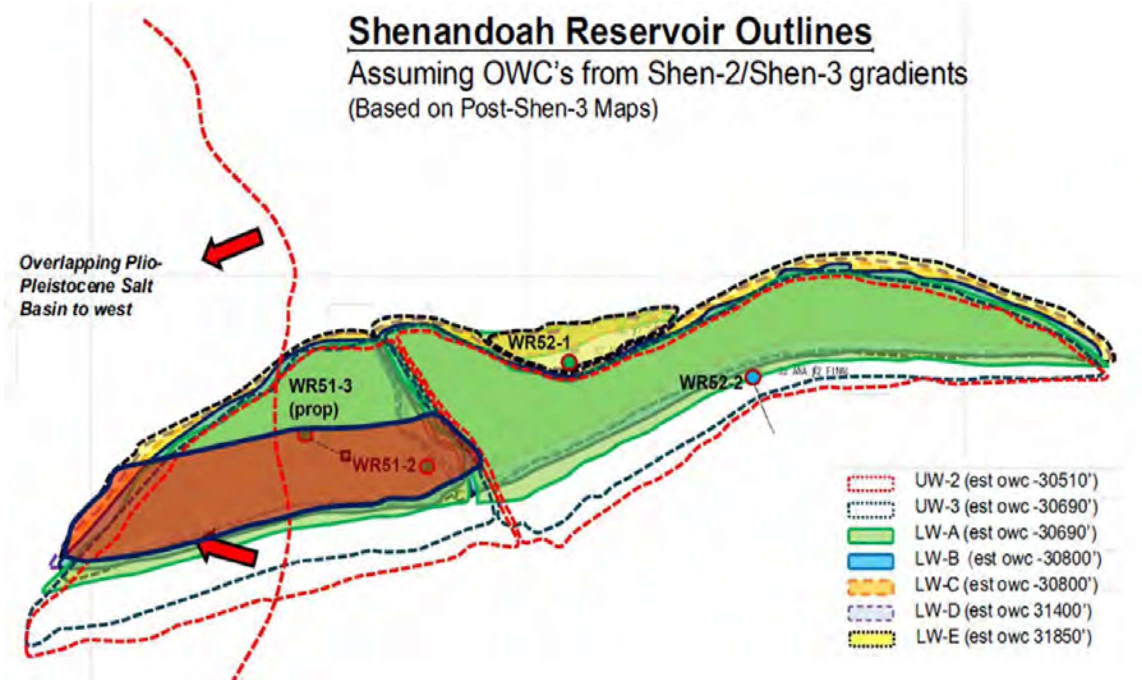


Figure 46 – Anadarko post-Shen-3 oil distribution maps with estimated OWCs based upon projected pressures from Shen-2 oil column and Shen-3 water column. Projecting the same OWC on both sides of the interpreted fault implies that the oil column on each side is not only in pressure contact with the aquifer, but that oil has equalized across the fault and that the fault is interpreted as non-sealing.[402]

443. Each of the Shenandoah partners, as well as both Anadarko's Exploration and Development teams, revised their estimated volumes for Shenandoah downwards following Shen-3. Anadarko's Exploration team lowered their estimates by maintaining their reservoir-by-reservoir deterministic calculation methodology, updating their P10 oil-water contact location to that based upon highest-known-water ("HKW") in the Shen-3 well and updating their most likely oil-water contact location to that based upon pressure gradient measurements in the Shen-2 and Shen-3 wells. The Exploration team also considered the possibility that there may be a fault separating the oil accumulation between the Shen-2 well to the west and the Shen-3 well to the east, giving rise to two sets of Exploration volumes, as illustrated in **Table 10**, below:

[402] Marathon_004825 at -838.

	P90	P50	Mean	P10
Post Drill Shen #2	950	1180	1200	1470
Post Drill Shen #3 (No Fault)	780	910	920	1060
Post Drill Shen# (Fault)	565	725	740	940

Table 10 – Comparison of Exploration resource volumes following Shen-3.[403]

444. After Shen-3, ConocoPhillips revised their mean estimate to 307 MMBOE,[404] Marathon revised their mean estimate to 398 MMBOE,[405] and Cobalt revised their mean estimate for in-place volumes to 1753 MMBO, which, when multiplied by an estimated recovery factor of 20%, resulted in a mean recoverable volume estimate of 350 MMBOE.[406] The estimated recovery factor of 20% was commonly used early on by members of the partnership, and was recognized to carry uncertainties which would be better assessed by Development after additional whole core and development options were explored. In spite of the differences expressed by partners in their estimated recoverable volumes, each partner had similar maps defining the extent of the trapped oil, including OWCs that extended across any potential faults.[407]

[403] APC-00153588 at -588.

[404] ANACOP00014518 at slide 49.

[405] Marathon_003734 at slide 72.

[406] Marathon_003170 at slide 3.

[407] APC-00001085 slide 18.

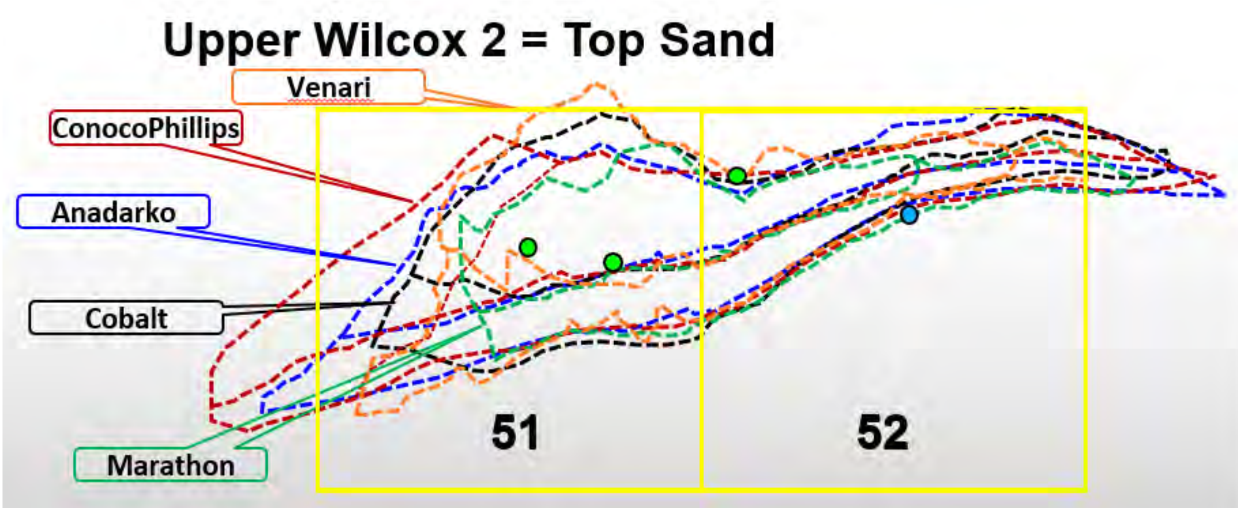


Figure 47 – A comparison of Upper Wilcox oil sands extent by partner at Shenandoah before the drilling of the Shen-4 well. Maps demonstrate very similar views to the east. Western differences are based upon uncertainty in base of the allochthonous salt. Volumetric differences between companies are also being driven by estimated variations in recovery efficiencies (14%-28%). Note that the projected down-dip OWC is estimated similarly by all partners and is common across any interpreted faults.[408]

2. Alleged Misstatements

a. *Amended Complaint ¶ 52: The Shen-3 well "continued to validate the company's geologic models"*

445. The Shen-3 appraisal well results "continued to validate the company's geologic models" and were "laying the foundation for [a] potential future mega project."[409]

446. A "geologic model" is a description of the distribution and arrangement of sediments and fluids that is based upon the processes that deposited them. It is a combination of the depositional environment (how and where they were deposited) and of the facies sequences (the composition and sorting/layering of the materials) that characterize it. The "geologic model" is a function of the deposition that had taken place and is not directly related to where the oil is currently trapped.

[408] APC-00001085 at slide 18.

[409] Dkt. 55 – Amended Complaint, ¶ 52.

447. Validating the geologic model is important for estimating the properties and characteristics of the reservoir as one moves away from each of the well bores. Given the poor resolution of the seismic imaging, understanding the characteristics of the reservoir between and laterally away from the wells determines both how to develop the field, and is critical to estimating how the field will perform.

448. At Shenandoah, each appraisal well penetration tested the extent of this depositional model and this information is independent of whether hydrocarbons are penetrated. The Shen-3 well validated the deep-water marine turbidite depositional model by demonstrating strong lateral continuity with the Shen-2 well and providing consistent well log sediment sequences. The Shen-3 well supported a geologic model of turbidites with demonstrated depositional continuity, well-defined Bouma sequences,[410] down-dip thickening, and laterally continuous deposition and properties. Prior to the Shen-3 well, the Development team's geo-modeler, Mr. Noll, proposed a turbidite geologic model that captured the architectural depositional elements that had been documented in analogues.[411] After the Shen-3 well confirmed the Shen-2 key depositional elements (LW fan and 3 UW fans) and major facies, Mr. Noll shared his model with partners.[412] The Shen-3 well provided a key element for "validating" the lateral continuity and distribution of reservoir properties across the model.

[410] Bouma sequences are characteristic of turbidite deposition and are defined by a recognizable sequence of sediment structures with a fining-upward sand grain distribution.

[411] APC-00001962 at slide 7.

[412] APC-00000996 at slides 12, 16.

b. *Amended Complaint ¶ 97: "The Shenandoah-3 well confirmed the sand depositional environment . . . ."*

449. "Depositional environment" is defined as a portion of the earth's surface that "is characterized by an unique set of physical, biological, and chemical processes"[413] where sediments are deposited. Each of these environments have certain characteristics that make each of them different than from one another. Different depositional environments will exhibit different structures and sedimentary texture. Determining the depositional environment that characterizes an oil and gas accumulation is important because it allows the proper analogues to be applied to predict the lateral distribution of the reservoir properties more accurately. Deepwater marine sediment deposition is a common depositional environment for the deepwater Gulf of Mexico Wilcox formation.

450. A "depositional system is a three-dimensional assemblage of lithofacies formed within a particular environmental setting."[414] It describes the manner in which sediment was deposited in the forming of the geologic formation. A depositional environment may have a variety of depositional systems populating it. Potential depositional systems for deepwater marine sedimentation include "sediment-gravity processes (slides, slumps, debris flows, and turbidity currents) and bottom currents . . . although pelagic and hemipelagic deposition is also important."[415]

451. Turbidite sand sedimentation defines the best reservoirs in these depositional systems. Typical deepwater marine settings include "channelized systems; channel-levee complexes; and sheet complexes (including lobes). . . . Deep-water marine sandstone systems can

[413] Reineck, Hans-Erich and Indra Bir Singh, "Depositional Environments" Chapter 1 in *Depositional Sedimentary Environments*, Springer (2nd ed. 1980) p. 5.

[414] Society of Exploration Geophysicists Wiki – *Depositional System*.

[415] Deep-Marine Sediments by G. Shanmugam at 264 (2019).

be difficult to characterize in the subsurface. The basic problem is in trying to differentiate sheet sandstones from channel complexes. . . . It is not always easy to assess this with limited well control. This is a particular problem when it comes to the costly appraisal of deep-marine sandstone reservoirs offshore."[416]

452. A "deep water marine turbidite" depositional environment is understood to be "among the best of the various sedimentary environments that comprise reservoirs. Porosities, permeabilities, and net-to-gross ratios are typically high. Under favorable conditions, deep-water sandstones may be ponded and stacked vertically into very thick, sand-rich intervals. These reservoirs are very profitable as they can be produced by a small number of wells at very high rates."[417]

453. The statement that "[t]he Shenandoah-3 well confirmed the sand depositional environment" represented the best-known information available at that time. Examination of the Shen-3 well logs that define depositional stacking patterns, along with strong lateral layer correlations with the Shen-2 well,[418] and the successful collection of rotary sidewall samples together confirmed the depositional environment at Shenandoah as deep water marine turbidites.[419]

454. An environment of deposition describing the turbidite deposition of the Upper and Lower Wilcox sands for the region was proposed prior to drilling the Shen-1 well,[420] confirmed

---

[416] AAPG Wiki – *Deep-water Marine Reservoirs*.

[417] *Id.*

[418] *See* APC-00001466 at slide 11.

[419] *See* APC-00002203; ANACOP00006964 at slide 3.

[420] *See* APC-00285180 at -197.

by the Shen-1 discovery,[421] confirmed for the down-dip fault block by the Shen-2 well where Upper Wilcox was present and better defined, and then confirmed again laterally down-dip and to the east by the Shen-3 well.[422] While some uncertainty remained, an understanding of the orientation and full extent of each of the facies in the depositional model can only be determined by step-out appraisal wells or by reservoir production.

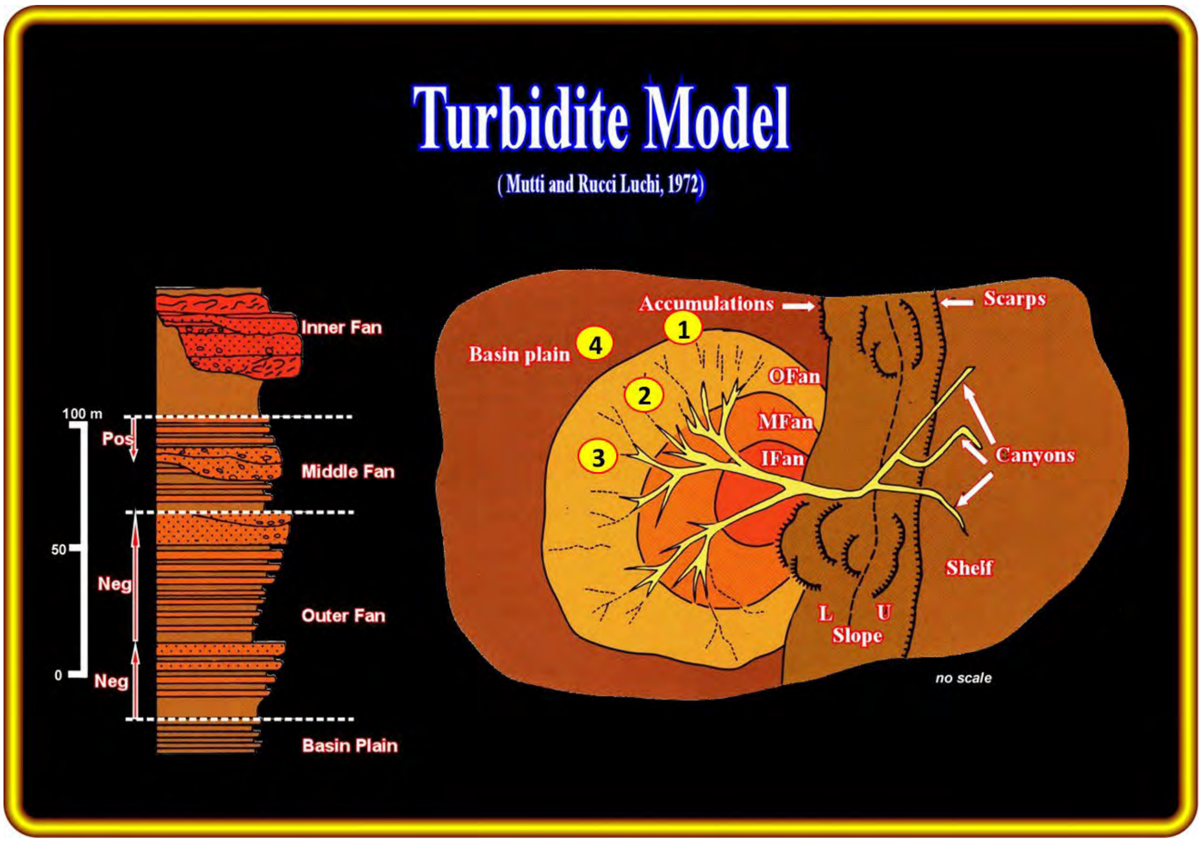


Figure 48 – Example of turbidite depositional model indicating how the wells at different locations help to define where in the depositional system one is exploring and giving indications of what reservoir continuity one should expect.[423]

[421] APC-00001023.

[422] *See* ANACOP00006964 at slide 3.

[423] Cramez, Carlos "Turbidite Deposits: Turbidite Facies & Related Processes," September 2014, http://homepage.ufp.pt/biblioteca/Turbidite%20Depositional%20Systems/Pages/Page7.htm (numbered positions added by Dr. R Detomo, Jr.).

455. When appraising a turbidite discovery, one would like to understand the position of the wells with respect to the orientation of the deposition system (*see* **Figure 48** above). If the Shen-2 appraisal well were located in the #2 position above, then one would like to understand which direction in the depositional system additional Outer Fan facies would be located. An appraisal well that found sediments indicating the #4 position would have limited the extent in that direction of the Outer Fan facies. An appraisal well drilled in location-3 would have confirmed lateral continuity of the Outer Fan facies. However, confirming Outer Fan facies continuity from the #2 position to the #3 position would not remove the uncertainty in appraising the #1 position.

c. *Amended Complaint ¶ 97: "The Shenandoah-3 well confirmed . . . lateral sand continuity . . . ."*

456. The lateral continuity of each sand is an important property to assess when evaluating an oil and gas accumulation. "Lateral sand continuity" is controlled by the depositional environment and its systems and is a property of the reservoir determined at the time it was deposited. Turbidite deposition was described extensively in sedimentological literature,[424] and depending on where one is within the depositional system affects the expected lateral continuity of the reservoir sands.

457. **Figure 48** shows the different components of the turbidite system and the different stacking pattern one would expect to see in a well to help identify where in the fan one is located. Reservoir sands in the "Outer Fan" are deposited in an extensive sheet and in a continuous, uninterrupted process. They would be expected to demonstrate strong "lateral sand continuity." Sands deposited in the Middle or Inner Fan would have less extensive deposition. Locating the

[424] *See, e.g.*, Mutti, Emiliano, Daniel Bernoulli, Franco Ricci Lucchi, and Roberto Tinterri, "Turbidites and Turbidity Currents from Alpine 'Flysch' to the Exploration of Continental Margins," Sedimentology, Vol. 56, 2009.

nature and extent of each reservoir sand would help determine the producibility of each sand and the lateral distribution of its reservoir properties.

458. Sand "continuity" is different from sand "connectivity." Although "sand continuity" is a property of a sediment at depositional time, "sand connectivity" from one location to another location in a reservoir can change over time. "Reservoir connectivity, and its inverse, compartmentalization, is a critical area of petroleum industry research and business application."[425] Connectivity between two sand layer locations is characterized by fluid and/or pressure communication between those locations. Processes that affect the sand after deposition is complete (*e.g.*, faulting, diagenesis, pore plugging, etc.) may compartmentalize the sand even though its continuity was excellent at depositional time.

459. "A compartment is precisely defined as a trap which has no internal boundaries which would allow fluids to reach equilibrium at more than one elevation. Compartment boundaries include sealing faults, channel margins, shale-draped clinoforms, paleokarst fractures and other diagenetic boundaries. These can separate hydrocarbons and aquifers within a field or discovery."[426] Since offshore wells are drilled at a large spacing, unless the seismic imaging is excellent, it is very difficult to unambiguously determine the connectivity of sands without well testing or production of them.

460. The statement that "[t]he Shenandoah-3 well confirmed . . . lateral sand continuity," was the Shenandoah partnership's accepted interpretation at the time, especially given the strong correlation between Shen-2 and Shen-3. As noted in the presentation for a February 2014 partner meeting, "Lateral Stratigraphic Confirmation" of the sands seen at Shen-2 was a key objective of

---

[425] IPTC 11375, *Reservoir Connectivity: Definitions, Examples, and Strategies*, J. W. Snedden, et. al., at 1.

[426] *Id.*

the Shen-3 well.[427] The uncertainty of "lateral reservoir communication" was also captured in a pre-drill Shen-3 note from Mr. Chandler.[428] After drilling the Shen-3 well, the presentation for a December 2014 partnership meeting, Shen-3's goal of "[e]stablish [l]ateral [c]ontinuity" had been "[a]ccomplished," as there were "Highly Correlative Reservoirs Encountered between Shenandoah 2 and 3."[429] This correlation was used to determine that these sands were deposited in extensive layers between the two wells, allowing for reasonable interpolation of the layers' thicknesses and properties between the penetrated areas. However, since these two wells had neither an oil column nor a water column in common, an oil sand "connectivity" uncertainty between these wells remained. In addition, the extent to which the sand was laterally deposited in areas away from these two wells, especially to the east, west, and down-dip of the well control, was still uncertain.

461. Paul Chandler testified about the difference between "continuity" and "connectivity" and the fact that the Shen-3 well confirmed lateral sand continuity. He stated: "A. The Shenandoah 3 was easy to correlate once we got the well to TD and could get all the data and it showed actually great correlation and great continuity between the Shen 2 and the Shen 3. Q. When there is faulting, how does that impact sand continuity? A. It has minimal impact on the sand continuity. All the faulting does is just break that reservoir rock as it's faulted. But it doesn't impact the continuity of the sand."[430]

462. Relatedly, in response to a question about a potential faulting between Shen-2 and Shen-3, Mr. Ramsey testified that a sealing fault "could be one potential" reason for the two wells

[427] APC-00000907 at slide 7.

[428] APC-00007619 at -620.

[429] APC-00001146 at slide 5.

[430] Chandler Dep. Tr. 151:21-152:5.

not being connected, but that other “stratigraphic disconnects” could cause a “sand discontinuity”, including “the reservoir just not laterally extending from one well location to the other.”[431] Mr. Ramsey depicted a cross-section of Shenandoah reflecting a lateral thinning to depositional pinch-out of the Upper Wilcox UW-1 reservoir between the up-dip Shen-2 well and the down-dip Shen-3 well.[432] Although the overall depositional Upper Wilcox interval drawn in his cross-section demonstrates downdip thickening and depositional continuity between Shen-2 to Shen-3, the UW-1 sand was not observed at the Shen-3 well. This could have been due to depositional thickness variations due to paleo-topography during deposition or could be due to the UW-1 consisting of thin meandering channels at the top of the turbidite sequence that the Shen-3 happened to not penetrate. This vertical “deposition sequence” is well understood in the Oil & Gas Industry and was described by ConocoPhillips in their pre- and post-Shen-3 modeling: “Early in depositional history salt modified surface provides confinement and channelized flow[.] As Wilcox deposition begins to overwhelm surface topography turbidite flows are less confined and knick point moves further updip.”[433]

463. As deposition wanes at the top of each of the fan systems, channelized deposits that are not as laterally continuously deposited occur. The absence of the Upper-Wilcox 1 sand (the upper-most oil-bearing sand in the Shen-2 well) in Shen-3, does not detract from the identification of the turbidite system between the two wells as being continuous, without an interruption of the turbidite deposition by some other structural or competing sedimentary system (*e.g.*, a channel or debris flow). This depositional continuity helps in understanding the relative

---

[431] Ramsey Dep. Tr. 35:21-36:12.

[432] APC-00016936 (Ramsey Dep. Ex. 229a).

[433] ANACOP00009201 at slide 13.

position of each well in the turbidite depositional system and supports a strong "lateral sand continuity" depositional interpretation between the two wells.

464. The statement "confirmed lateral sand continuity" does not imply that every layer of sand found in the Shen-2 well was also found in the Shen-3 well, such that each layer was in pressure communication "continuously" between the two wells. Rather, it references that the major sand sequences were confirmed as being continuous between the two wells. The Upper Wilcox fan, and the interpreted three Lower Wilcox fans, were interpreted as laterally correlated and continuous.[434] Since the UW-1 only represented a very small fraction of the targeted reservoir sands, (less than 30 feet out of more than 1,000 feet or less than 3% of the Wilcox reservoirs)[435], the interpretation that these sands were deposited in a "laterally continuous" manner between the two wells, as expected in this depositional environment, was reasonable.

465. Successfully demonstrating "lateral sand continuity" between the two wells does not mean that all uncertainty has been removed, especially as one steps away from the existing well and seismic control into the un-appraised areas to the west and east. Therefore, "Lateral sand continuity" will continue to be an "appraisal objective" of each future well.

d. *Amended Complaint ¶ 97: "The Shenandoah-3 well confirmed . . . excellent reservoir qualities . . . ."*

466. "Reservoir quality" generally refers to the size, porosity, and permeability of the reservoir. The American Association of Petroleum Geologists states: "The quality of a reservoir is defined by its hydrocarbon storage capacity and deliverability. The hydrocarbon storage capacity is characterized by the effective porosity and the size of the reservoir, whereas the deliverability is

[434] APC-00000996 at slide 16.

[435] APC-00001146 at slide 10.

a function of the permeability. Effective porosity is the volume percentage of interconnected pores in a rock."[436]

467. The Shen-2 well encountered "excellent reservoir quality" as determined by the well logs and agreed with by partners: "Shenandoah 2 . . . Highest Net Pay of any Wilcox well to date and within top tier of Deepwater GOM discoveries."[437] The Shen-3 well also encountered "Excellent Reservoir Quality"[438] as determined by the well logs and by the core samples taken, "High Quality Reservoir Sands in Aquifer (17 – 19% Poro")."[439] The reservoir quality of the Shenandoah wells is among the best for any Gulf of Mexico Paleogene discovery.[440]

468. Although there was some degradation of the permeability down-dip in the Shen-3 well,[441] observing a decrease in the permeability in the down-dip wet leg of a deep-water turbidite is not unusual and chemical processes associated with the water commonly act to reduce the reservoir properties. Even so, the measured reservoir quality is excellent compared to other Gulf of Mexico Paleogene discoveries.[442]

e. *Amended Complaint ¶ 97: "The Shenandoah-3 well . . . found approximately 50% (1,470 feet) more of the same reservoir sands [and] confirmed . . . down-dip thickening."*

469. "Down-dip thickening" generally refers to the thickening of sediment deposition as one moves "down-dip" from its supply location to the center of its depositional accommodation space, so long as the sediment supply can fill such space. "Accommodation space" is "the space

---

[436] AAPG Wiki – *Reservoir quality*.

[437] ANACOP00008087 at -100.

[438] APC-00014422 at slide 1.

[439] APC-00002204 at -207.

[440] *See* APC-00704016 at slide 11.

[441] Marathon_014736 at slides 12-13.

[442] *See* APC-00704016 at slide 11.

made available for the accumulation of sediment that results from global sea level change and subsidence,"[443] usually some type of low-spot or a slope level lower than the supply location. In turbidite deposition, the sediments move down-dip from their up-dip canyons to fill the down-dip accommodation space, creating a recognizable sequence that is characterized by sands initially thickening down-dip, until one reached the limits of the deposition and then the sediments will begin to thin once again.[444]

470. The model at **Figure 48**, above, demonstrates the lateral continuity across each of the turbidite fans' components. The deposition is controlled by the sediment supply (from the canyons on the right) to fill the accommodation space available on the basin plain (left).

471. The term "downdip thickening" generally refers to the entire depositional system and all the sediments within it. Downdip sand thickening would include the total sand between the top and base of the depositional system, accounting for the fact that as one individual sand unit thins, another may thicken to accommodate the available space. However, with downdip sand thickening, the total sand would be thickening down-dip and be deposited in a laterally continuous manner until one begins to reach the down-dip terminus of the turbidite deposition. "In large turbidite systems (LTS), the bulk of the sandstone occurs in non-channelized and elongated bodies (lobes) in the outer region of the system. These potential reservoirs are characterized by lateral continuity and a tabular geometry over distances up to several tens of kilometers parallel to the current direction."[445]

---

[443] AAPG Wiki – *Sequence stratigraphy*.

[444] Cramez, Carlos, "Turbidite Deposits: Mutti's Model," September 2014, http://homepage.ufp.pt/biblioteca/Turbidite%20Depositional%20Systems/Pages/Page13.htm.

[445] Turbidite Systems in Hydrocarbon Exploration Figs. 60, 65 - Universidade Fernando Pessoa, Porto, Portugal.

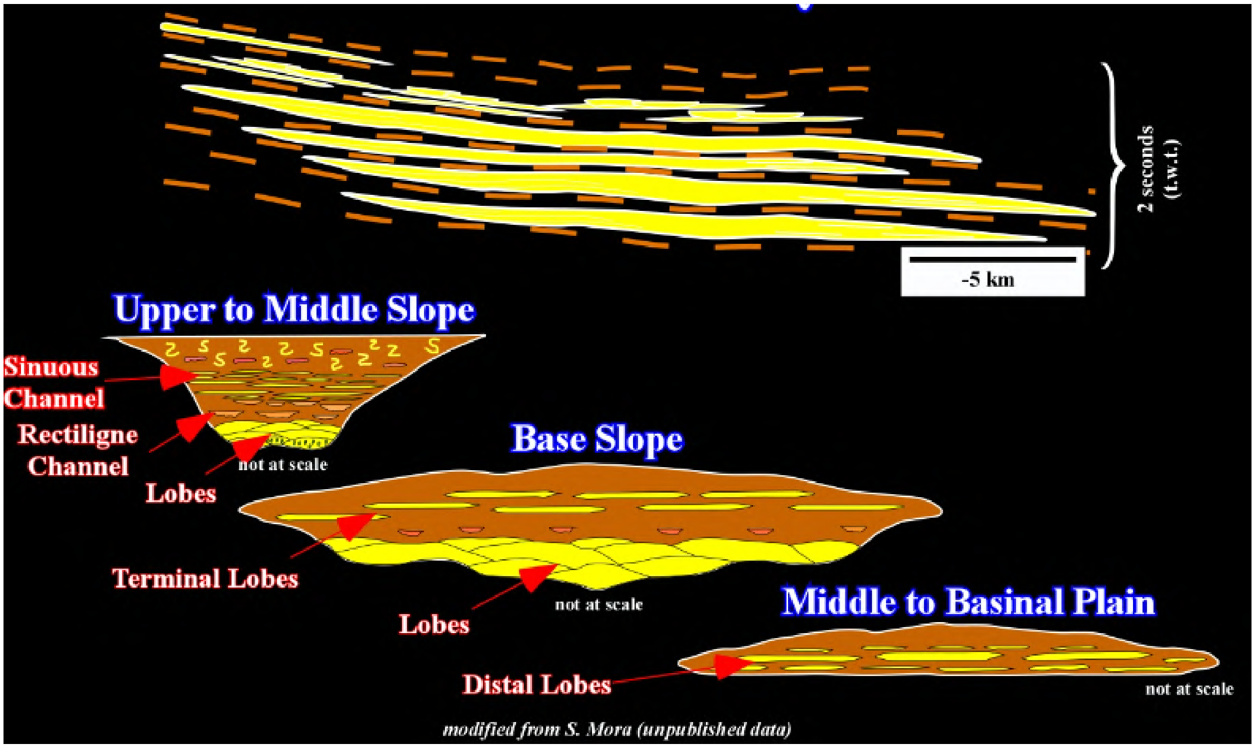


Figure 49 – Classic turbidite depositional model demonstrating the distribution of sand and shale facies that one might expect depending where one is located within the system. There is strong lateral sand continuity in the downdip direction and within the major components of each fan.

472. When appraising a turbidite reservoir, it is important to understand where the supply had come from, and where in the turbidite system one's resources are located. Knowing that the deposition of the reservoir sands "thicken downdip" identifies that accommodation space existed there when the sand was deposited. This is important in estimating the potential size of the connected water-bearing reservoir, which is important in estimating the expansion energy available to drive the oil up and out of the reservoir. This is an important factor in estimating the expected "recovery efficiency" that the production of the field will experience.

473. The Shen-2 well logged eight sand zones with a total vertical sand thickness (TVT) of 1001 feet. The Shen-3 well logged seven of those eight sands (all but the Upper Wilcox 1) with an Anadarko-determined total vertical thickness of 1470 feet, confirming down-dip thickening of

the depositional turbidite system and equating to an approximately 50% increase of the total reservoir sand.[446]

474. The fact that Shen-2 encountered hydrocarbons while Shen-3 did not is irrelevant to this conclusion, as this comparison is only one of the thicknesses of the *reservoir* sands found in each well, regardless of whether or not they are oil bearing. Hydrocarbon-bearing reservoir sands are typically referred to as "pay sands," and when discovered, they are commonly described in terms of their "net feet of oil pay."[447] I am unaware of any public statement by Anadarko or any of the partners describing the Shen-3 well as having encountered oil or pay sands.

f. *Amended Complaint ¶ 97: "The Shenandoah-3 well . . . reduced the uncertainty of the resource range."*

475. Anadarko's Exploration group made resource estimates using a range of possibilities on key unknowns, meaning that a range of possible resource sizes were determined. Typically, these were stated in terms of P90 (low end, 90% probability that the resource is at least that big); P50 (middle estimate; 50% probability that the resource is at least that big) or Mean (average of low-end and high-end estimates); and P10 (high end, 10% probability that the resource is at least that big).

476. Before drilling and evaluating the Shen-3 well, the uncertainty in the in-place resource range included uncertainty of the extent of any oil in the eastern region of the mapped trap, uncertainty in the extent of oil in the western region of the mapped trap, and the uncertainty in the down-dip extent of the Shen-2 penetrated oil column. There were also uncertainties about the quality and extent of the down-dip aquifer and concerning the lateral consistency of the rock

[446] APC-00002204 at -207.

[447] *See e.g.*, Press Release, *Anadarko Announces Shenandoah Appraisal Well Encounters More Than 1,000 Net Feet Of Oil Pay*, March 19, 2013, APC-00572655.

and fluid properties. The Shen-3 well reduced the uncertainty in the projected down-dip extent of the oil column by limiting the extent of down-dip oil by a projected oil-water contact. Rock and fluid property information was collected and information of thickening into the down-dip aquifer was confirmed. Together, this information reduced the overall possible in-place resources.

477. **Table 11**, below shows Anadarko and other Shenandoah partners' resource estimates before and after Shen-3, and the reduction in uncertainty ranges:

	Pre Shen-3				**Post Shen-3**			
Company	P90	Mean	P10	Uncertainty Range	P90	Mean	P10	Uncertainty Range
Anadarko (Non-Faulted)	952	1197	1469	517	780	920	1060	280
Anadarko (Faulted)	-	-	-	-	565	740	940	375
Marathon	202	508	906	704	260	398	608	348
ConocoPhillips	431	699	960	529	191	307	489	298

Table 11 – Summary of Partner resource estimates before and after Shen-3.[448]

g. *Amended Complaint ¶ 97: "The Shenandoah-3 well . . . enabled the projection of oil-water contacts based on pressure data . . . ."*

478. Because oil is lighter than water, it generally sits on top of water in the same reservoir. The oil-water contact is the depth at which oil is no longer present and is instead replaced by water. Confirming the oil-water contact of an accumulation is an important step for determining the proved, possible, and probable size of the resource that is in place.

479. Fluid contacts can be "determined" or "established" by penetrating the contact with a wellbore, or they can be "projected" via pressures and fluid densities measured up-dip and down-

[448] APC-00585873, p. 1.; Marathon_000001, p. 107; Marathon_000411, pp. 16-18; APC-00153588, p. 1; *Marathon_003734, p. 3.; and *ANACOP00014518, p. 49. (For sources marked with an asterisk, P values were calculated from reported STOOIPs using a 20% recovery factor. Marathon pre-Shen-3 estimate was converted to MMBOE using calculated Marathon ratio of 1 MMstb = 1.144 MMboe.)

dip if a wellbore does not drill through the contact. The difference between drilling through the OWC and merely projecting it is commonly understood in the oil and gas industry.

480. In fact, the SEC and the Society of Petroleum Engineers provide guidance on when this it is appropriate to project OWCs for purposes of estimating proven, probable, and "possible" resources: "In the absence of data on fluid contacts, proved quantities in a reservoir are limited by the lowest known hydrocarbons (LKH) as seen in a well penetration unless geoscience, engineering, or performance data and reliable technology establishes a lower contact with reasonable certainty."[449] "Possible reserves may be assigned to areas that are structurally higher or lower than the proved area if these areas are in communication with the proved reservoir."[450] "Portions of the reservoir that do not meet this reasonable certainty criterion may be assigned as probable and possible oil or gas reserves based on reservoir fluid properties and pressure gradient interpretations."[451]

[449] APC-00001289 at -410.

[450] *Id.* at -408

[451] *Id.*

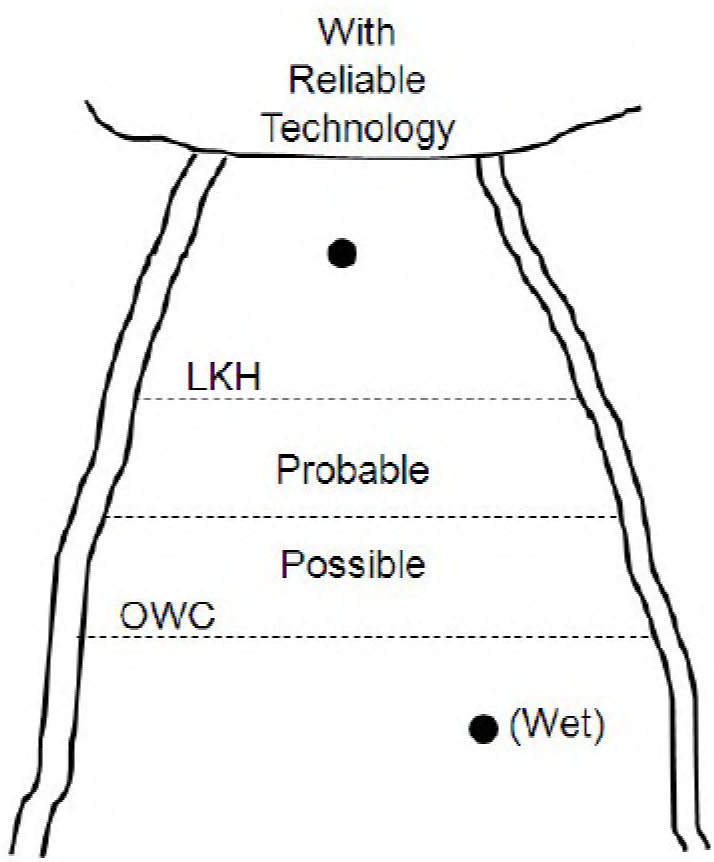


Figure 50 – Figure demonstrating how one might consider classifying resource volumes as proved, probable, or possible using pressure in two wells in pressure communication with each other and projecting estimated OWCs.[452]

481. There is a crucial distinction between "projecting" OWCs and "establishing" them definitively. Whereas the latter can be accomplished only by drilling through the OWC itself, the former can be accomplished by using data from a well drilled above the OWC and a well drilled below the OWC, as is the case with the Shen-2 and Shen-3 wells.[453]

[452] APC-00001289 at p. 16-2.

[453] Oudin Dep. Tr. 237:15–239:3; Camden Dep. Tr. 221:25–224:17.

(a) OWC Penetrations

482. The only well penetration of an unambiguous OWC at the Shenandoah prospect was at the Shen-1 discovery well in the Lower Wilcox "A" and "C" sands.[454] No Upper Wilcox sands were present in the Shen-1 well. These OWCs were mapped along the measured structural contour. However, without a penetrated OWC in the Lower Wilcox "D" or "E" sands, those OWCs were estimated based upon the calculated sealing capacity of the shale above each sand. The interpretation was that if any oil existed below this level, the buoyant pressure of such an extensive column would cause the oil to leak and that oil could not likely exist below this level in this fault block. No other Shenandoah well ever penetrated such an OWC.[455]

(b) OWCs Estimated from Mapped Spill Points and Sealing Capacity

483. The oil pressures measured in the "D" sands and "E" sands in Shen-1, and pressures that would cause the overlying shale to fracture measured in the drilling of the well, were used to calculate the estimated OWC for the "D" and "E" sands, which was used to position the Shen-2 appraisal in an effort to penetrate this down-dip estimated OWC and determine the down-dip extent of the oil in the "D" and "E" sands.[456] However, Shen-2 found significantly more sands (including encountering oil in the Upper Wilcox "1", "2" and "3" sands), and the "A" and "B" sands which, in Shen-2, were located considerably down-dip of Shen-1, and were oil filled-to-base. In addition, all oil pressures in Shen-2 were not on the same pressure gradient as those in Shen-1. Together, these results clearly indicated that Shen-1 sands were not connected to Shen-2 sands and that some barrier, either a fault or a salt-weld unconformity must exist separating them.

[454] Marathon_000001 at slide 28.

[455] APC-00590469.

[456] *Id.*

484. The Shen-2 appraisal well left the evaluation teams with an estimated LKO for each of the eight reservoir sands that contained hydrocarbons (Upper Wilcox 1, 2 and 3, and Lower Wilcox A, B, C, D and E), but no direct knowledge of the location of the OWC for any sand. Initially, Anadarko again used oil pressures, this time from Shen-2, and calculations of sealing capacity from Shen-2 well fracture gradient measurements to estimate the down-dip "spill" location of each sand's OWC.[457]

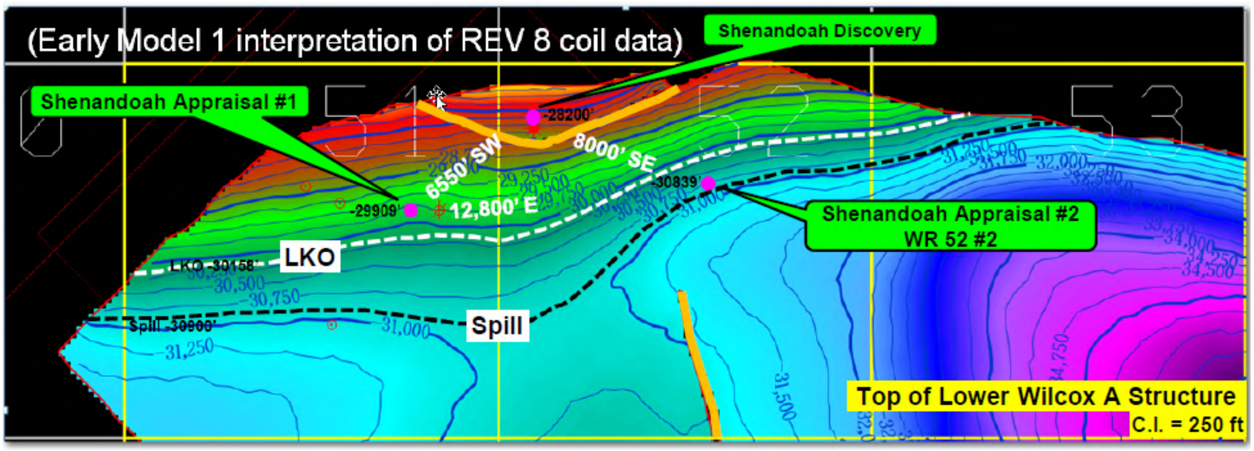


Figure 51 – Anadarko Exploration pre-drill Shen-3 mapping where the Shen-3 planned location is based upon being below Lowest Known Oil in Shen-2, and being just above the mapped reservoir spill depth, while testing the reservoir continuity to the east.[458]

485. Once water pressures from wells drilled in prospects near the Shenandoah prospect (Yucatan, Coronado, Lewis) were available, those were also used to project OWCs at Shenandoah. These estimated OWCs were then used to position the Shen-3 appraisal well location, which was drilled to the east of Shen-2 in an effort to penetrate some of the sands' OWCs. As noted above, however, Shen-3 was further down-dip than had been mapped and all sands at this location were filled with water (*i.e.*, no OWC was penetrated, because the well was down-dip of the OWCs).

(c) OWCs Estimated from Pressures

[457] APC-00000907 at slide 7.

[458] *Id.*

CONFIDENTIAL

486. Following the drilling of Shen-3, Anadarko's Exploration and Development teams used pressure data obtained from that well to project OWCs for every oil sand in every fault block.

487. After Shen-3 was drilled, Anadarko had one well (Shen-2) that encountered eight hydrocarbon-bearing sands but was drilled above the OWC in each sand, and it had one well (Shen-3) that encountered seven of the same eight sands (all but the "Upper Wilcox 1" sand) and was drilled below the OWC. This enabled Anadarko and the Shenandoah partners to project an OWC between the two wells utilizing the same principles illustrated in **Figure 52** below, because Anadarko interpreted Shen-2 and Shen-3 to share a common aquifer.

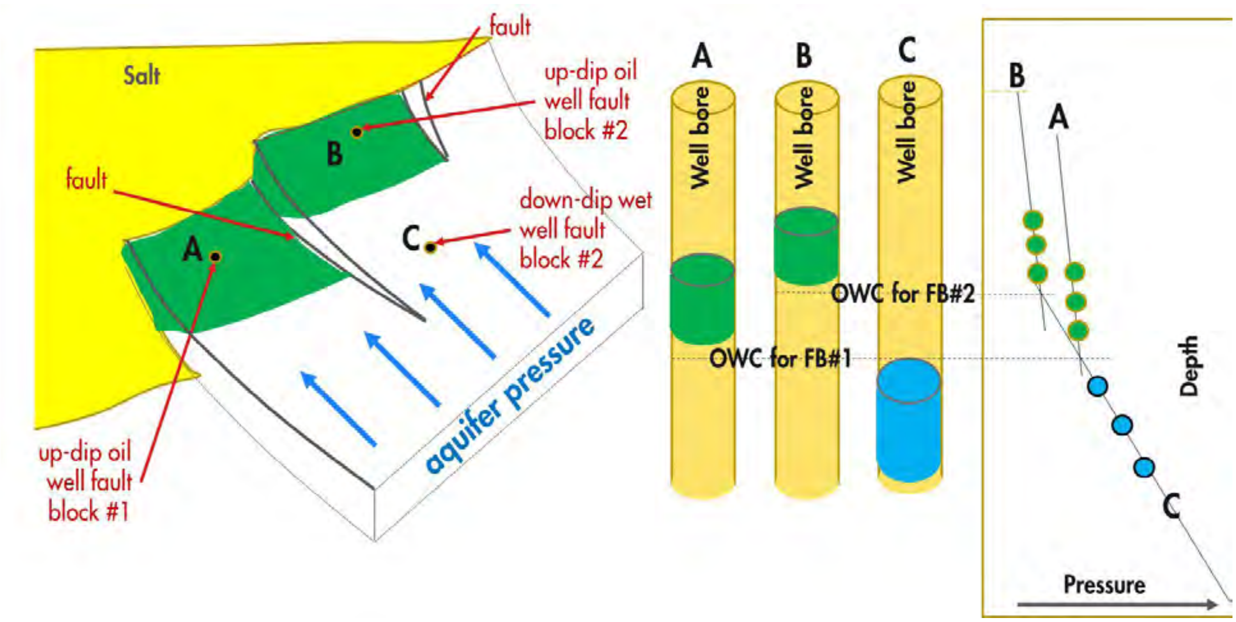


Figure 52 – Diagram showing how a sealing fault can give rise to different oil columns in each fault block but both fault blocks can still be in pressure communication with a common aquifer. Well "A" is Shen-2 and Well "C" is Shen-3. This principle can be used to project an estimated OWCs for each fault block when no OWC has been penetrated with a well.

488. These projected OWCs would be applicable to any potential fault block that was in communication with the common down-dip aquifer and was applied across the structure map. partners had interpreted a possible fault between Shen-2 and Shen-3, but the fact that they also

interpreted a common OWC for sands on either side of this fault illustrates that they interpreted the wells to be pressure communicating across the fault.

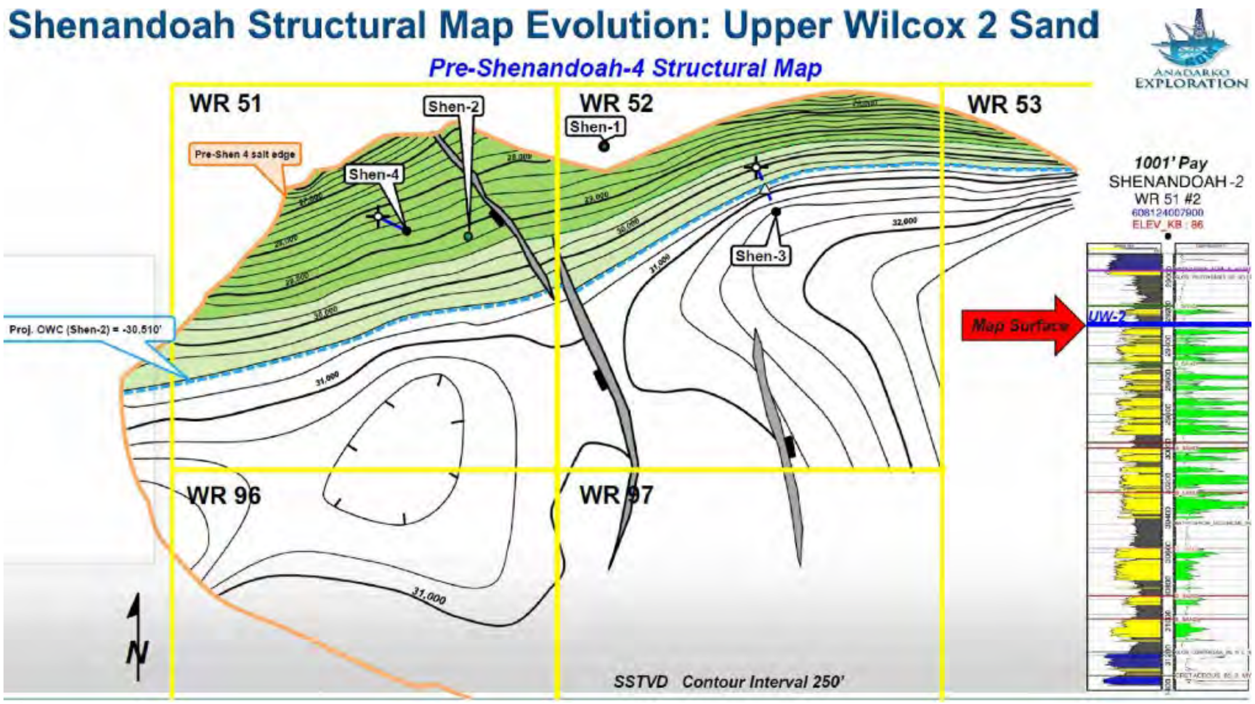


Figure 53 – Anadarko Exploration mapping post Shen-3 appraisal well. Anadarko Exploration updated their maps indicating a north-south set of faults that separate the oil reservoir in the Shen-2 appraisal well from the area up-dip of the Shen-3 appraisal. However, they carried a common projected OWC based upon pressures across these faults that indicates an interpretation of communication across the faults.[459]

489. Chris Camden testified about how he used MDT pressure data gathered from November 12 to November 14, 2014, to project OWCs between Shen-2 and Shen-3 using this method, as depicted in a presentation to the Shenandoah partners dated December 10, 2014.[460] In fact, a July 2014 presentation analyzing Yucatan #2 well data had already noted that "Log Signature and corresponding MDT pressures suggest Upper Wilcox 3 and Lower Wilcox A & B

[459] Marathon_011477 at slide 12.

[460] Camden Dep. Tr. 223:14-224:1; APC-00018078 at slides 23-25.

sands form one large amalgamated hydraulic unit. Implies potential aquifer support at Shenandoah."[461]

490. Mr. Ramsey noted that his and Mr. Camden's evaluation of the combined data of oil-staining of wet sands and projected OWCs based upon pressure were consistent in estimating OWC locations: "I had a chance to review the MDT pressure data with Chris Camden and the projected oil-water contact for the Upper Wilcox 2 sand is potentially only a couple hundred feet up the hill from our current well penetration point. Given this close proximity, it is also a probable scenario that the residual oil we have in our UW2 penetration point, is an indicator of a paleo hydrocarbon level, and signifies a minor shift in our column that took place as the structure built/tilted to its present day configuration. The MDT pressure data also suggests the remaining 6 sands have OWCs significantly deeper than the lowest known oil seen in the WR51 #2 well."[462]

491. This methodology of using pressures from a common down-dip aquifer to estimate pressures in each fault block would be used by each company in the partnership, although the level of confidence assigned to these estimates varied by company. For instance, Marathon noted that the Shen-3 "down-dip test in [the] eastern part of field [found water] pressures [that] allowed calculation of [an] OWC at ~30,510'."[463]

492. Prior to drilling the Shen-3 well, the best estimate of Shen-2 oil-water contacts was based upon the basin spill points mapped from the poorly imaged seismic. Therefore, P90 oil-water contacts were interpreted to only extend to the Shen-2 well base-of-sand depths, and the P10 oil-water contacts were projected to be these mapped basin spill points. The most likely oil-water

[461] Camden Dep. Tr. 94:4-104:9; APC-00010161 at slide 2.

[462] APC-00617121 at -121.

[463] Marathon_014240 at slide 8.

contacts (P50) were estimated between the two based upon the midpoint of volumes on a Rose & Associates Log-Log plot.[464] After Shen-3, the estimated oil-water contacts were moved higher, and the corresponding reservoir areas and volumes were reduced based upon this upward revision.[465]

493. Using up-dip oil pressures and down-dip water pressures assumes that there is pressure connectivity between the Shen-2 and Shen-3 wells through the down-dip aquifer. At the completion of Shen-3, there was no evidence that the two wells were pressure separated, or that any mapped fault system was either sealing or extensive enough to seal into the down-dip aquifer. Since no oil column was encountered in Shen-3, it was impossible to disprove connectivity between the Shen-2 and Shen-3 wells. It was recognized that the oil-water contact most likely was between Lowest-Known-Oil (LKO) of Shen-2 well and Highest-Known-Water (HKW) of the Shen-3 well. Therefore, projections of the "most likely" location of oil-water contacts were made using these pressures. However, it was also recognized that uncertainty remained due to unproven connectivity.

494. Some members of the Development team were less confident in Exploration's projected oil-water contacts.[466] Mr. McGrievy noted: "We do not necessarily agree that the preponderance of MDT data suggests that we are near OWC's in the U & L Wilcox sands, perhaps only a few hundred feet up-dip, as exploration advertises at this point. Although we cannot refute it as it is a possible outcome . . . in our opinion, with the current data set, is that we can neither prove nor disprove an OWC contact as the results of the data are not convincingly definitive in

[464] *See, e.g.*, APC-00001024.

[465] *See, e.g.*, APC-00002094.

[466] *See, e.g.*, APC-00617121 (Oudin Dep. Ex. 115) at -121.

any scenario and we cannot sanction with this potentially ambiguous data set despite the level of optimism from exploration. We still need another well in this FB to prove the column height."[467] Mr. Chandler also made note that projecting oil-water contacts using pressure carried uncertainty that would likely need to eventually be addressed with a well: "As for the [OWC] projection, like Chip said it is not definitive at all. It will take a well to prove that. We will certainly need to re-open that discussion about the location of Shen 4."[468] These emails reflect that the Development team did not think that the Exploration team was wrong; it just did not have as much confidence in the projections of the oil-water contacts as Exploration.[469] Differences of technical opinions are common and important to oil and gas exploration. Where uncertainties are large, each discipline brings unique experiences and viewpoints, and weighing incomplete information is important for determining how best to move forward and whether to sanction a project for development.

495. Some members of the Development team were concerned with the risk of faulting. For example, [470] in an email regarding a potential fault that had been mapped, Mr. Browning notes that "[i]f the 'Pink' fault seals, the oil-water contact in the S3 fault block is independent from the S2 fault block."[471] As Mr. Chandler testified, they were "looking at the possibility of fractures and faults of some magnitude based on the OBMI data that we had. And we were trying to incorporate that into our existing structure map work."[472] Mr. Chandler's August 2014 mapping showed a structure with faults separating the oil column in Shen-2 from the possible oil column at the

[467] APC-00617218 (Oudin Dep. Ex. 116) at -218.

[468] APC-00617135 (Chandler Dep. Ex. 203) at -135.

[469] *See also* Oudin Dep. Tr. 125:16-126:24.

[470] APC-00004967 at -967.

[471] APC-00004970 at -971.

[472] Chandler Dep. Tr. 91:5-11.

planned Shen-3 location.[473] However, it does not show compartmentalized reservoirs separated throughout the water column which would discount pressure connectivity. Additionally, Mr. Chandler's study concluded: "There are currently no seismic interpreted faults that cut the wellbore [in the Shen-2 well] so therefore there are none that correspond to any of OBMI interpreted faults."[474]

496. While the Development team's structure map, shown in **Figure 54**, below, included extensive faulting, it also shows that they were interpreting that the fault blocks were in pressure communication with each other. Specifically, they have indicated two "red" lines that follow the structural contours of the map on either side of interpreted faults. The solid "red" line is drawn as the "Highest Known Water" ("HKW") and is the most down-dip OWC that one could expect given the Shen-3 results. It follows a structural contour that corresponds to a depth of 29,900 feet. The dashed "red" line is drawn and labeled as the "Lowest Known Oil" ("LKO") the highest possible OWC as determined from the Shen-2 well, and it is drawn at a structural contour that corresponds to a depth of 29,134 feet. One can observe from this Development team map that both these possible oil-water contacts are carried across the interpreted faulting. If the Shen-2 and Shen-3 wells were completely isolated from each other, including in the down-dip aquifer, it would make no sense to carry the Shen-2 derived LKO possible oil-water contacts to the east, across the fault, to the Shen-3 "fault block." Likewise, it would make no sense to carry the Shen-3 derived HKW possible oil-water contact to the west across the fault to the Shen-2 "fault block." In fact, both oil-water contact lines are carried further to the east and to the west across other faults in a continuous manner indicating Development's interpretation of there being both potential oil resources in those

[473] APC-00830435 (Chandler Dep. Ex. 106) at slide 3.

[474] *Id.* at slide 14.

areas, and of those areas likely having the same OWC. This interpretation only makes sense if all fault blocks were in pressure communication with each other.

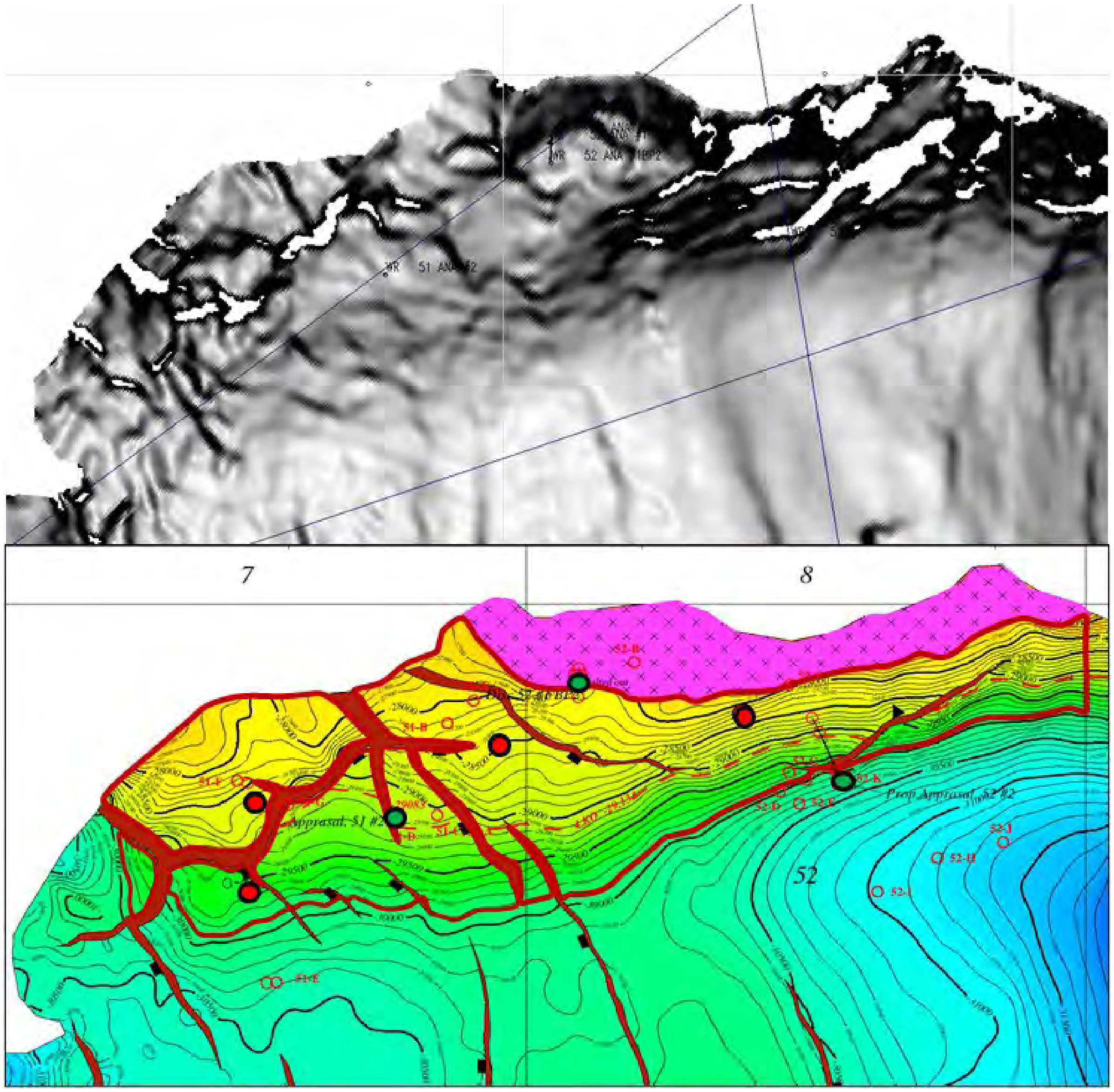


Figure 54 – Comparison of Anadarko Development team's seismic dip map and its interpreted structural map with faulting after Shen-3 appraisal well. Note that all the drilled wells (in green) are in poorly imaged areas. (Future possible appraisal well sites are in red.)[475]

[475] APC-00648353 at slides 1, 3.

497. Merrill argues that the wells likely were not in pressure communication. This is not supported by the evidence. At the time the Shen-3 well finished drilling, Anadarko's Exploration team had no clear evidence that the Shen-2 well and the Shen-3 well were not in pressure communication with each other through a common aquifer. At that time, the only hints of faulting were north-south, and they did not appear to extend across the basin. Thus, even if there was a fault between Shen-2 and Shen-3 such that the two wells were in different fault blocks that would have different oil-water contacts, it was still reasonable to use Shen-3 pressure data to project the oil-water contact back up-dip towards Shen-2. Under the assumption that the Shen-2 and Shen-3 sand zones are in communication with each other, the depths at which the oil pressure gradients from the Shen-2 well intersect the water pressure gradients from the Shen-3 well defines the "likely location" of the oil-water contact and was a reasonable method for estimating either probable or possible resources. Absent any additional data, this estimate for the oil-water contact would typically serve as the P50 (most likely) location of the OWC for each reservoir sand in resource volume calculations.[476] This methodology and the use of Shen-3 water pressures was supported and used by the Anadarko Exploration and Development teams, as well as all partners, throughout the appraisal program for the Shen-2, Shen-4 ST, and Shen-5 wells.

h. *Amended Complaint ¶ 102: "[Shenandoah-3] was a very successful appraisal well"*

498. There is no single definition for what it means to be a "successful" appraisal well, but under any reasonable definition there is little doubt that Shen-3 would be considered a "successful" appraisal well.

[476] APC-00001146 at slides 49-53.

499. Since the purpose of an appraisal well is to help reduce uncertainty in the field that is being appraised, and to allow the company to move towards being able to make a sanctioning decision, one common definition of a successful appraisal well is that it is one that helps gather information about the field. "Once an exploration well has found hydrocarbons, considerable effort will still be required to accurately assess the potential of the discovery and the role of appraisal is to provide cost-effective information that will be used for subsequent decisions (development). During appraisal, more wells are drilled to collect information and samples from the reservoir and other seismic survey might also be acquired in order to better delineate the reservoir. This phase of the E& P process aims to reduce the range of uncertainty in the volumes of hydrocarbons in place[,] define the size and configuration of the reservoir[,] and collect data for the prediction of the performance of the reservoir during the forecasted production life."[477]

500. A form of this definition was adopted by Chip Oudin, when he stated that a successful appraisal well is one that "provides you with information that helps you further characterize the field or what will become the field."[478] Chris Camden provided a similar definition, saying that a "successful" well is one that: (i) is "drilled safely", (ii) is drilled in an "environmentally responsible" way, and (iii) gathers data that "refine[s] our estimates," as compared to, say, a well that is not even successfully drilled.[479]

501. For the reasons described above (*i.e.*, that the Shen-3 well confirmed lateral sand continuity, the sand depositional environment, and down-dip thickening; enabled the projection of the OWCs based on pressure data; and reduced uncertainty in the resource range), the Shen-3 well

[477] Oil & Gas Portal Technologies – "Upstream Field Appraisal Phase," https://www.oil-gasportal.com/upstream/field-appraisal-phase/

[478] Oudin Dep. Tr. 244:22-24.

[479] Camden Dep. Tr. 220:6-221:1.

undoubtedly helped delimit the Shenandoah field and moved Anadarko and the partners closer to being able to make a sanctioning decision.

502. Importantly, appraisal wells are not always successful within this understanding. Indeed, not all of the appraisal wells drilled in the Shenandoah basin would qualify as "successful" under this definition. At the Coronado discovery within the Shenandoah basin, Chevron suffered a failed appraisal in 2014. Chevron "abandoned a test on the northern portion of Block 143 in 2011: [The] #1 OCS G21849 [well] was junked and abandoned after drilling to 12,000 ft [in 2014]. The 2013 Coronado discovery, #1 OCS G21841 on Block 98 hit more than 400 net ft of oil pay in the same mini-basin as Anadarko Petroleum's nearby Shenandoah discovery."[480]

503. Alternatively, an appraisal well might be defined as "successful" if it meets a substantial number of its pre-drill objectives. The Society of Petroleum Engineers (SPE) notes that appraisal wells are "[n]ormally used to run buildup tests, drill stem tests, [determine] top and bottom of formations, gather core or fluid samples or other evaluations."[481] Where wells are drilled with these specific tests or objectives in mind, the well could be considered "successful" if those tests are performed successfully or the specific data points that the well is seeking are gathered.

504. The pre-drill objectives for the Shen-3 well were agreed upon by partners at their February 2014 Partner Meeting.[482] They were:

> "1.) Lateral Stratigraphic Confirmation.
> 2.) Structurally Down-Dip of Shenandoah Appraisal Sand Penetrations by 800 to 900 ft.
> 3.) Remain Within Well Imaged "Shenandoah" Closure

[480] "Chevron Drilling At Coronado Prospect," Hart Energy, June 18, 2014, https://www.hartenergy.com/activity-highlights/chevron-drilling-coronado-prospect-140990.

[481] SPE PetroWiki, Glossary – *Appraisal well.*

[482] APC-00000907 at slide 7.

4.) SPUD before WR52 Lease Expiration (May 31st 2014)"

505. Additionally, the Development reservoir engineers identified determining the "Depositional environment" as critical to their development planning process.[483]

506. Similarly, Anadarko's Development team identified the following "Key Unknowns" that the Shen-3 appraisal well was designed to help address:[484]

- "Lateral continuity (degree of homogeneity) and presence and quality of sand
- Depositional system and facies distribution necessary for performance prediction
- O/W contacts for reservoir container sizing
- Penetration in water leg to understand sand quality and degree of aquifer support"

507. Each of these uncertainties was addressed by the successful execution of the Shen-3 well. Mr. Strickling confirmed that the objectives of the Shen-3 sppraisal were met, "as an appraisal well, we met our number-one objective, which was lateral sand continuity, and we collected information that would have allowed us to project an oil-water contact."[485] In addition, the partners agreed that the predrill objectives of the well were also met, even though the penetration was further down-dip than anticipated.[486]

508. Indeed, rather than penetrating the oil column, one of the stated objectives of Shen-3 was to penetrate the water leg.[487] Thus, the fact that Shen-3 was a wet well has little bearing on whether the well was a "successful appraisal well." While Plaintiffs have suggested during depositions that Shen-3 was unsuccessful because the Shen-3 AFE's described a "success case" as

[483] *See* APC-00001026 at slide 10; APC-00000671 at slide 3.

[484] APC-00000671 at slide 3.

[485] Strickling Dep. Tr. 99:22-25.

[486] *See* APC-00001146 at slide 5; APC-00002204 at slide 4; APC-00157431 (Ramsey Dep. Ex. 227) at slide 4.

[487] APC-00000671 at slide 3.

one in which the well "encounter[s] oil via LWD,"[488] this is irrelevant to whether Shen-3 was a "successful appraisal well." As discussed above, Mr. Strickling indicated that "success" of the Shen-3 sppraisal was defined by safely meeting the well's objectives and allowing for logging and an evaluation program of the reservoir[489] and not just based upon penetrating oil.

i. *Amended Complaint ¶ 95(g): "Shen 3 was a dry hole"*

509. The term "dry hole" is an accounting term. As discussed above, it is generally defined in the oil and gas industry as a well that is "unsuccessful or noncommercial"[490] —a definition that assumes that the goal of the well is targeting producible hydrocarbons. Wells that have intentionally targeted non-productive zones for the gathering of appraisal information, such as the Shen-3 well (which was drilled down-dip of LKO with the goal of encountering OWCs or a free water aquifer) would more commonly be described as a "wet well" rather than a "dry hole."

510. Anadarko's 10-K Filing makes it clear that the Shen-3 well was "1,500 feet down-dip" of Shen-2, and that pressure data was used "for the projection of oil-water contacts."[491] This is commonly understood to only be possible if the well drills into down-dip water. The term "dry hole" is therefore inconsistent with the common understanding of that term, in light of Shen-3's stated objectives.

511. Dr. Chernoff provided testimony on "dry hole," stating, "[A] dry hole, in my experience, is a very specific financial note -- or accounting classification. So a wet well could be

488 APC-00005092 at -094; Strickling Dep. Tr. 96:23-100:19.

489 Strickling Dep. Tr. 212:13-18.

490 AAPG Wiki – *Dry hole*.

491 APC 2014 Form 10-K at 9.

classified as a dry hole, but I -- there are other things that may also be classified as a dry hole, so I -- I wouldn't call them as synonymous."[492]

512. In any event, Anadarko did make it clear that the Shen-3 well did not encounter hydrocarbons. First, when announcing the Shen-3 well results in February 2015, they did not describe it as having encountered any hydrocarbons—unlike every other appraisal well that encountered hydrocarbons, for which there were very clear statements about how many feet of pay were found. Further, Anadarko did eventually explicitly state that Shen-3 was a "wet well", when Gwin stated on a February 2, 2016, earnings call that Shen-3 "was [a] wet well."[493]

513. The fact that different partners in a project dealt with the Shen-3 well costs in different ways (*e.g.*, ConocoPhillips expensed the Shen-3 well) is not uncommon in the oil & gas industry where companies each have their own processes. In fact, Mr. Strickling noted that whether to immediately expense such a well, or to carry it on the company's books as an asset for potential future capital depreciation, was influenced by each company's philosophy: "other places I've worked had a . . . philosophy that you expensed things as soon as possible to reduce taxes."[494]

514. The Shen-3 AFE reference to "dry hole cost" does not impact this analysis. The terms "dry hole" and "dry hole costs" are distinguishable in their use, such that the fact that Shen-3 encountered wet sands does not mean that the well would necessarily be characterized as a "dry hole" as that term has been described above. "Dry hole costs" are limited to those costs that are incurred to drill a well up to the point of reaching its location objective and evaluating it. The "dry hole costs" are usually quoted as the minimum costs to execute the well in a drilling execution

---

[492] Chernoff Dep. Tr. 100:16-24.

[493] February 2, 2016 Earnings Call Tr. at 10.

[494] Strickling Dep. Tr. 60:19-21.

"failure" case, where "failure" means no subsequent use for the wellbore. The "dry hole costs" are typically those costs that will be incurred to drill, evaluate, plug, and abandon the well if it has no commercial use, even if the well encounters hydrocarbons. If the well encounters hydrocarbons and those hydrocarbons are never produced, the well is deemed "uncommercial." Mr. Chandler also confirmed the use of the term "dry hole cost" in AFEs generally to mean only the minimal "cost to drill just the hole and evaluate just that hole."[495]

515. Conversely, if a well is deemed to have additional use as either a producing, injector or monitor well, then additional casings and equipment will need to be deployed to preserve the integrity of the wellbore and allow future access within it. These costs go beyond the "dry hole costs" associated with the well. In the case of an appraisal well being drilled (or sidetracked) for the sole purpose of encountering and evaluating hydrocarbon with well logs and/or core, if the well "misses" its target and finds only "wet sands" then there is no need to execute a full evaluation program and the well's "dry hole" (minimum) costs would only include the costs to drill, plug and abandon the well.

516. In 2015 Mr. Leyendecker indicates the categorization of the Shen-3 well as being "potentially useable as a future water injection well for pressure maintenance",[496] demonstrating that this possibility was still under consideration after the Shen-3 well was completed in 2014.

517. This was the case with the AFE No. 2087315 for drilling the Shen-3 well where objectives were defined as: "The primary purpose(s) of the WR 52 #2 is to (a) test the lateral continuity of the pay sands encountered in the WR 51 #2; (b) attempt to find/encounter the oil/water contact(s); and (c) attempt to establish pressure connectivity (through MDT's) to the pay

[495] Chandler Dep. Tr. 243:21-244:9.

[496] APC-00001791 at -791.

sands seen in the WR 51 #2."[497] In this case, Anadarko recognized that there was a reasonable chance of being too far down-dip and the AFE was specifically written to clearly associate the costs of the planned extensive evaluation program into whether or not they would successfully find the oil column. "[T]he 'dry hole case' equates to encountering wet sands and the 'success case' equates to encountering oil via LWD, mud logs or other tools while drilling through the objective section."[498]

518. After a well is drilled, a decision must be made as to the potential future usefulness of the wellbore. Often, wells can be re-entered for future sidetracks or re-purposed for use as a water injector well. With very expensive and deep wells, preserving a future cost-savings by "temporarily abandoning" ("TA-ing") the well and deferring a decision on whether or not it will be used is not uncommon. The "dry hole costs" usage in a well's AFE does not equate to how the well will be categorized or treated in the future.

519. Water injection to assist in providing more energy to drive the oil to the wellbore and to improve the recovery efficiency of the development is a common method for improving oil production. Deciding on if water injection is necessary depends upon the size and connectivity of the reservoir, and upon the size of the connected down-dip aquifer, both of which are difficult to determine with needed accuracy until after production has been occurring for months. Most deepwater wells can be repurposed at some level of cost depending on where one needs the bottom-hole location of an injector well to be positioned. Since a desired injector location is not typically determined in the appraisal process, any detailed analysis as to what would be necessary is commonly deferred until a development plan is matured.

[497] APC-00005092 (Strickling Dep. Ex. 186) at -593 (emphasis added).

[498] *Id.* at -594.

CONFIDENTIAL

3. Structure Mapping

520. When Shen-3 encountered only water-filled reservoir sands, Anadarko's Exploration and Development teams met to compare mapping and to agree on a path forward. By that point, the teams agreed that there was evidence for both east-west and north-south faulting.[499] Although possible faulting could be recognized from the seismic data in the central part of the Shenandoah basin (*i.e.*, south of the Shenandoah prospect), the poor seismic quality in the up-dip area of the wells and oil reservoir sands did not allow for confident fault mapping in the area of the Shenandoah prospect, on the northern end of the basin.[500]

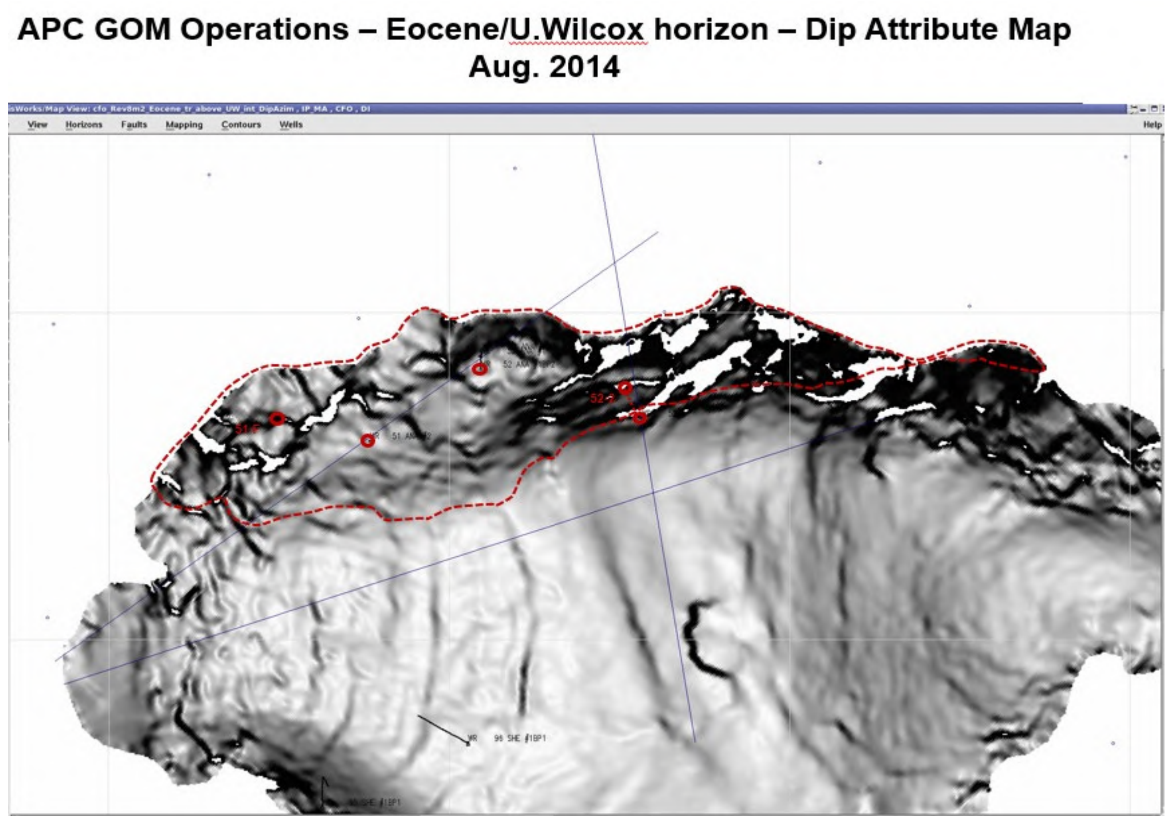


Figure 55 – Shenandoah dip map where darker zones indicate areas where there is an "inflection" in the seismically mapped structural horizon. These "inflections" were then interpreted as potential

[499] APC-00001048 at slide 23.

[500] APC-00001048 at slide 20.

faults. Note the poor character of this attribute in the up-dip area of the appraisal wells (red dots) and oil reservoir (red outline).[501]

521. Based upon their most confident internal mapping and the common elements from the compilation of faults mapped by partners, Anadarko's Exploration team began to incorporate a north-south fault into their mapping that divided the poorly imaged up-dip area into east and west sections that separated Shen-2 oil reservoir from any remaining untested Shen-3 up-dip oil reservoir.[502]

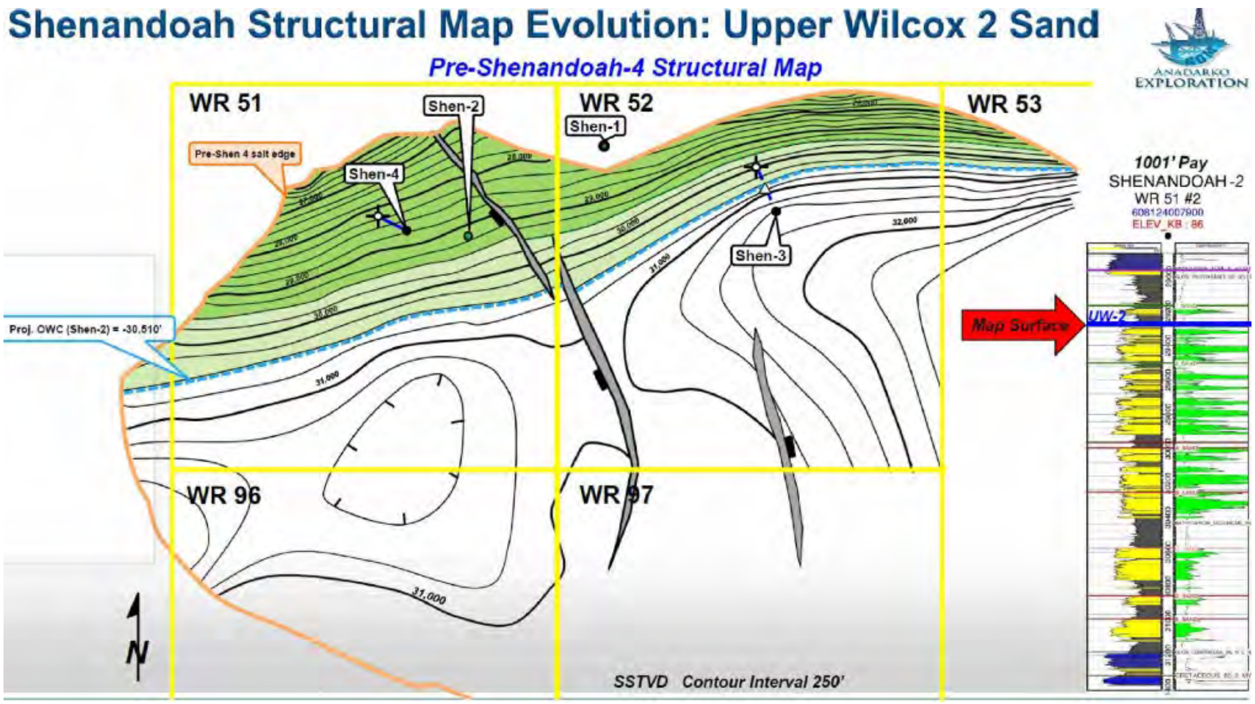


Figure 56 – Anadarko Exploration mapping prior to Shen-4 appraisal well spud. Anadarko Exploration had updated their maps indicating a north-south set of faults that separate the oil reservoir in the Shen-2 appraisal well from the area up-dip of the Shen-3 appraisal. Note that Shen-4 is a planned deviated hole up-dip.[503]

---

[501] *Id.*

[502] APC-00001146 at slide 9.

[503] Marathon_011477 at slide 12.

CONFIDENTIAL

522. Anadarko's Development team continued to map the Shenandoah prospect as having a complex series of faults based upon the seismic discordance images.[504] (see **Figure 56**.) By May 2015, just before Shen-4 was spud, each of the partners recognized some level of faulting in the field was likely, and each of the partners incorporated some level of north-south faulting into their mapping.[505] (See **Figures 57** through **61**, below.)

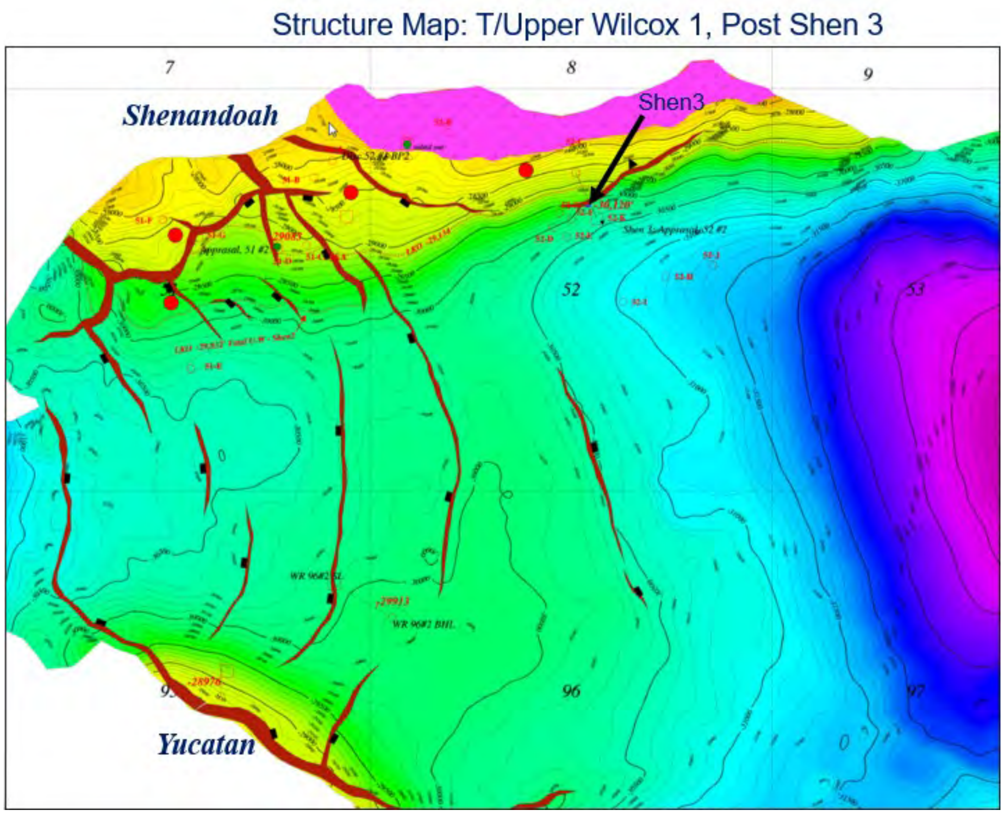


Figure 57 – Anadarko's Development team mapping post-Shen-3 maintaining the same significant faulting pattern interpreted from before Shen-3 results and still recognizing the possibility that Shen-2 oil may not be in a common fault block with Shen-3.[506] The "red dots" are potential future well locations.

[504] APC-00147996 at slide 2.

[505] *See* APC-00172770 (ConocoPhillips); Marathon_004816 (Cobalt); Marathon_004756 (Venari); -Marathon_006167 (Marathon).

[506] APC-00147996 at slide 2.

CONFIDENTIAL

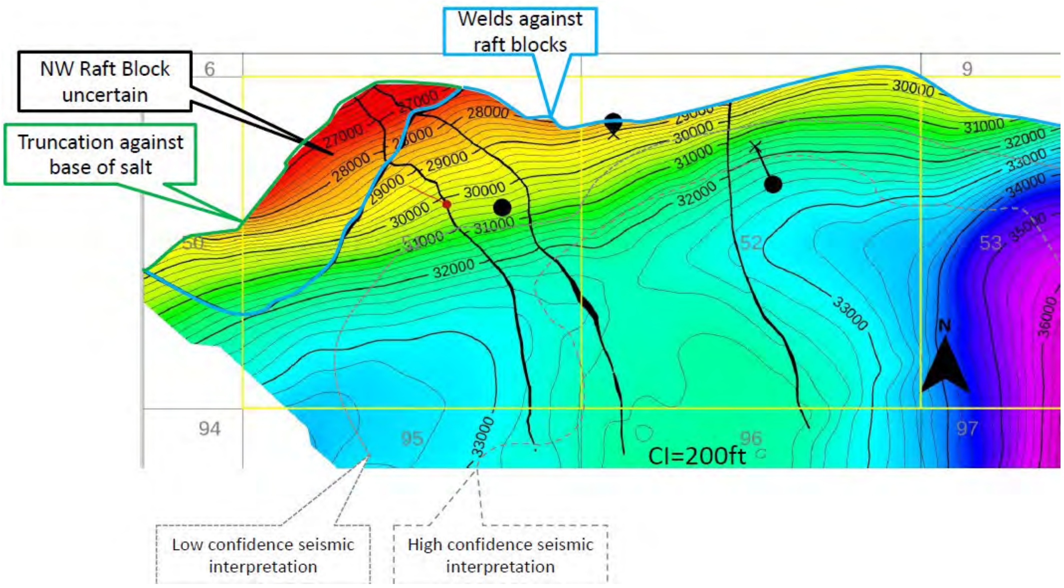


Figure 58 – ConocoPhillips map post-Shen-3 and before spud of Shen-4 (shown in red). ConocoPhillips maintained the same major faults in their interpretation from before Shen-3.[507]

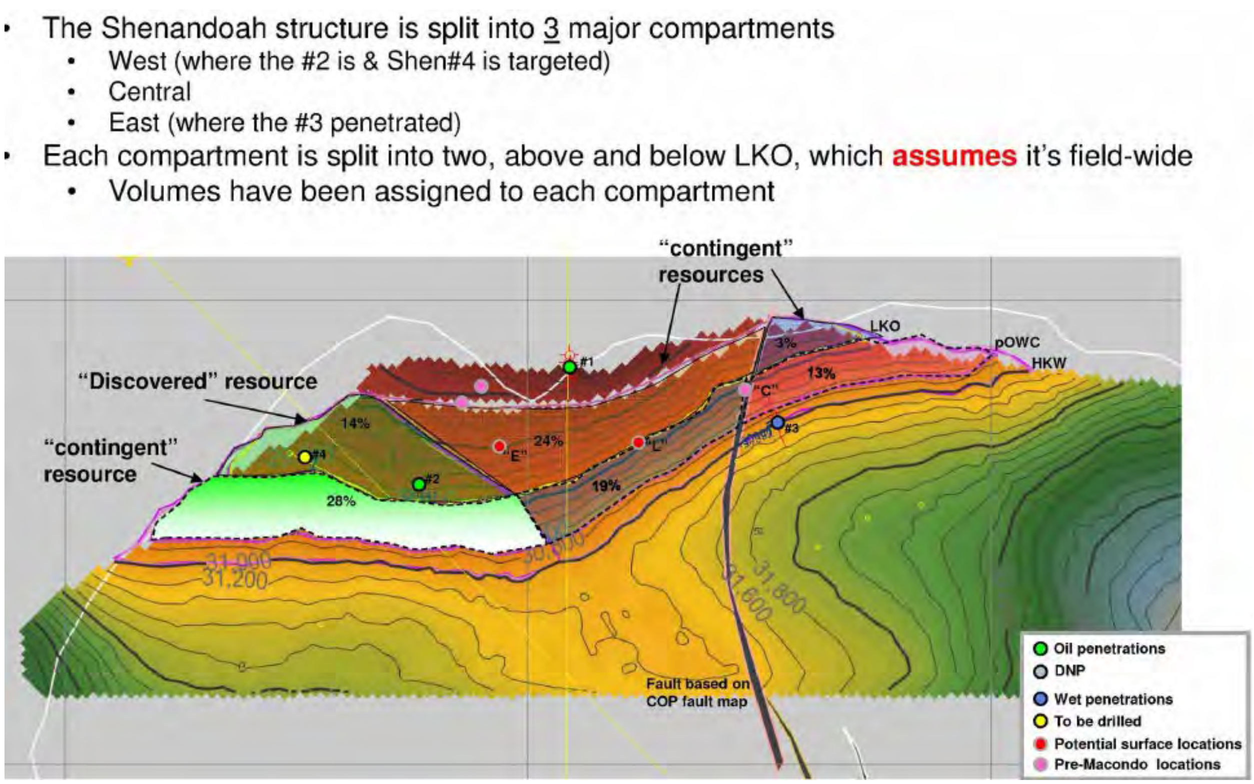


Figure 59 – Cobalt map post-Shen-3 and before spud of Shen-4 indicating north-south faulting although different from other partners.[508]

[507] APC-00172770 at slide 5.

[508] Marathon_004816 at -819.

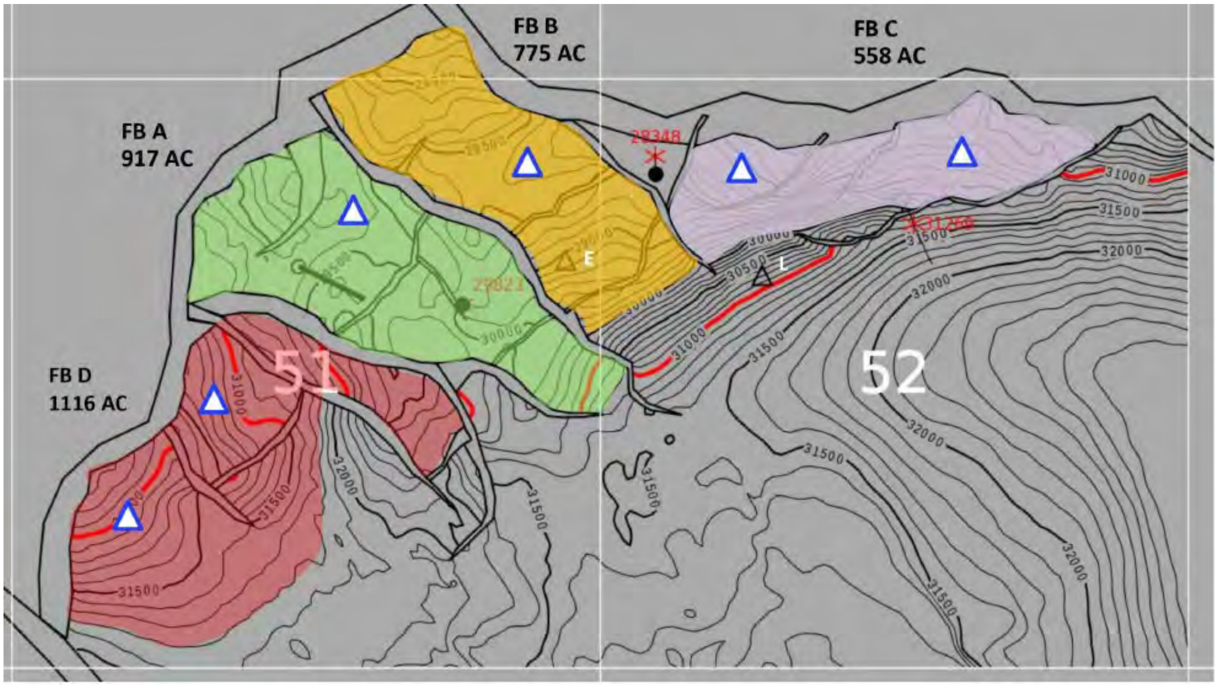


Figure 60 – Venari map post-Shen-3 and before spud of Shen-4 indicating north-south faulting also different from other partners.[509] Triangles are potential appraisal locations.

[509] Marathon_004756 at slide 2.

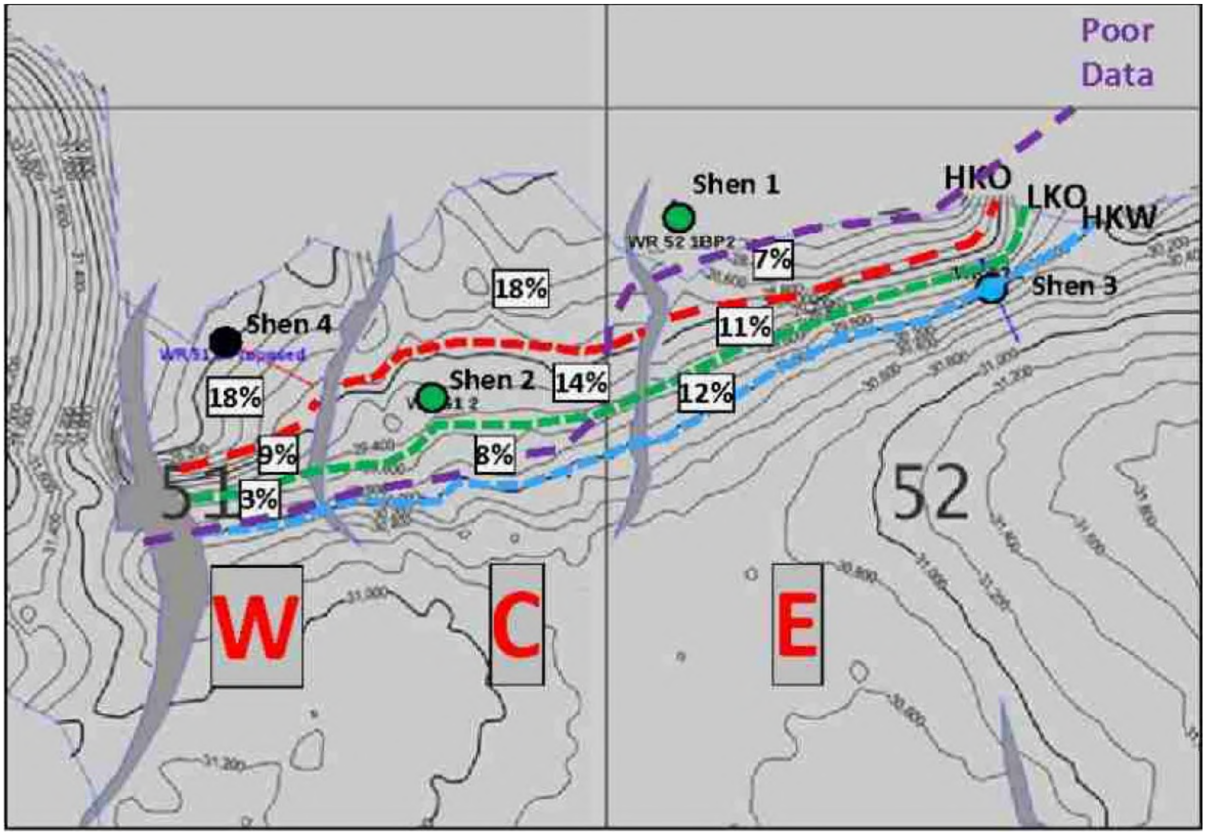


Figure 61 – Marathon map post-Shen-3 and before spud of Shen-4 indicating north-south faulting which is similar but different from other partners. Marathon maps the prospect as three different fault blocks (west, central, east) with a common OWC across all blocks.[510]

523. Shortly after the results of Shen-3, the reservoir simulation work by Mr. Shotts, discussed above in Paragraphs 244-246, was included in a technical presentation he was scheduled to give internally to Anadarko employees in mid-February. The Exploration team appropriately objected to the inclusion of sensitive, proprietary information regarding the ongoing appraisal, as well as the fact that the artificially placed faults included in the simulation were not geologic (*i.e.*, not observed through seismic or well data). Given the commercially sensitive nature of the information in question, the presentation was ultimately canceled.[511]

[510] Marathon_006167 at slide 8.

[511] Shotts Dep. Tr. 139:17-140:12 ("Shenandoah was very much in the appraisal phase. And the presentation was giving [sic] a -- to a much larger audience company-wide. And volumes of this sort are not something normally presented outside of the teams working it.")

524. In my opinion, it is entirely reasonable for management to exercise discretion regarding whether it is appropriate to share proprietary information concerning the results of an ongoing appraisal project with a wider audience. More importantly, the presentation's cancellation had no impact whatsoever on information sharing or technical analysis among the Shenandoah team at Anadarko or its partners, since the same simulations and technical discussion in question had been included previously in multiple presentations to the Shenandoah IPT team and partnership about six months earlier.[512] Based on my review of the documents, it is clear that Mr. Shotts's technical analysis was openly discussed and understood among the individuals responsible for carrying out the appraisal project, both within Anadarko and among the partners.

4. Rebuttal to Merrill Opinions re: Shen-3:

525. **Merrill ¶ 18(a):** "Shen's resource size shrank substantially with each well post-Shen-2 and fell below the range of expectations for the prospect post-Shen-2."

526. **Rebuttal to Merrill ¶ 18(a):** It is not clear what or whose "expectations" Dr. Merrill is referring to in his statement, or why Shen-2 would be used as the comparison point for those "expectations." There is also no evidence that Anadarko or partners released these resource estimates publicly. The internal estimates for the size of the Shenandoah resource did reduce after each appraisal well, although for different reasons and in different relative amounts. One purpose of appraisal is to better assess the size of the resource, and the appraisal program was accomplishing that. After Shen-3, Anadarko Exploration's resource assessments went down due to the reduction of down-dip area tested as wet by the Shen-3 well. Given that the trap was not full to the calculated maximum values, this reduction was unsurprising. Anadarko would have "expected" to learn information throughout the appraisal process to correctly assess the size and

[512] APC-00137267; APC-00001974.

value of the discovery and to be able to make decisions on the most economical way forward to derive value from it. The partners all shared this same expectation. Resource assessments and scoping economics were adjusted after each appraisal well and were used to guide where to drill the following appraisal wells.

527. **Merrill ¶ 18(d):** "Pressure data could not be used to reliably project OWCs across the Shen field following the results of Shen-3."

528. **Rebuttal to Merrill ¶ 18(d):** Since no well at Shenandoah ever drilled both water and oil, and since the water gradients at Shen-3 and Shen-6 were the same, there has never been any direct evidence that would indicate that one could not reliably use pressure data to project OWCs. Although the technical staff recognized that there was likely north-south faulting that may separate the oil columns of different fault blocks, and that there were far up-dip faults at Yucatan-1 and Shen-1 that isolated certain reservoirs, the evidence collected after Shen-3, and indeed throughout the appraisal program, supported the interpretation that the Shenandoah reservoirs were connected to a thickening, common downdip aquifer of amalgamated sands with joint connectivity in the center of the basin. Common water gradients in each of the future appraisal wells also supported this conclusion, and every partner estimated their reservoir OWCs in each fault block by projecting the pressures measured at Shen-3. Without a well penetration of an OWC, this methodology reliably provided the best estimate of where the OWC might be.

529. **Merrill ¶ 40:** "[W]ith the separation of Shen-2 and Shen-3 by a fault, the field's oil-water contact or maximum size is questionable. Resource estimates should have decreased because Shen-3 did not contain hydrocarbons and showed fault separation and/or compartmentalization of the prospect. Management had access to the exploration team's resource ranges, and it should have been a red flag as to the unreliability of the resource range for Shen.

Further, evidence indicates significant internal dissent by geoscientists and engineers on the joint Shen team from the pre-development department about the resource estimates by exploration management beginning in February 2014."

530. **Rebuttal to Merrill ¶ 40:** The interpretation of a north-south fault between Shen-2 and Shen-3 would not necessarily have any significant impact on resource estimates for the field. First, it was not known whether or not the fault sealed. If it did not seal, then the OWC across the fault should be the same. If it did seal, then the OWCs on each side of the fault could be different. Second, the size of the east and the west interpreted fault blocks are so large that there would be little or no impact on the number of wells necessary to produce either side. Yes, it was true that the OWCs were still uncertain, but that would have been the case whether or not a fault was interpreted between the east and west sides of the field. Finally, Merrill's conclusion that different perspectives between team members regarding the uncertainties facing the field should raise a "red flag" is untrue. Different perspectives on the uncertainties and a range of viewpoints is what a company's management encourages from its technical staff. The key is for that joint team to work together to arrive at a single, unified perspective, which was encouraged by management throughout.

531. **Merrill ¶ 74:** "Anadarko management conveyed to the public that Shen-3 was a successful well when it discovered the water leg in the field. Shen-2 found only oil- saturated sands and did not penetrate the oil-water contact, what Anadarko personnel internally called the 'worst case scenario.' Mapping shows Shen-2 is in a separate fault block, implying a different pressure regime from Shen-3. It is incorrect to define an oil-water contact using pressures measured in the two wells separated by a fault and likely not in communication."

532. **Rebuttal to Merrill ¶ 74:** As discussed above, based upon the agreed-upon pre-drill objectives of the Shen-3 well, it was appropriate to consider the well "successful." The well answered questions about lateral continuity and deposition model. It answered questions about depositional down-dip thickening and lateral reservoir quality. It answered questions about down-dip water quality and allowed an important bypass to be drilled to collect rock and fluid data. It did not penetrate the OWC, but did provide pressures that could be used to project OWCs. Based upon meeting these important objectives, the well was "successful." Merrill's statement that a fault between Shen-2 and Shen-3 implied "a different pressure regime" is also untrue. Since Shen-2 was all oil, and Shen-3 was all water, it is impossible to conclude definitively whether their pressure regimes are different.

533. **Merrill ¶ 80:** "Formation pressures are also used to infer the depth of oil-water contacts (OWC) when the pressure gradients of the oil column and underlying water column are known. The intersection of the oil column gradient and water column gradient is defined as the free-water level, a close approximation to the OWC in moderate to high permeability rock. When no OWC is encountered in a well, the pressure gradient of the water column must be based on results from another downdip well. The critical issue is that the downdip water column must be in pressure continuity with the updip oil column to establish the OWC. Sealing faults between the water and oil leg prevent such pressure continuity; lateral continuity of the sands is also a critical factor in assessing whether a well provides useful information about the depth of OWC's."

534. **Rebuttal to Merrill ¶ 80:** Merrill neglects to state that as turbidite sands thicken into the growing accommodation space in the center of the basin, that it is very likely that these thickening sands onlap each other and would thus be in pressure communication. This improves

the likelihood that the basin center aquifer is both vertically and laterally connected across the basin, and that only the most significant faults would be likely to separate it into any compartments.

535. **Merrill ¶ 81:** "Figure 26 shows that the water leg of Shen-3 lined up with Shen-1, not Shen-2, and thus could not be used to project OWCs across the field based on Anadarko's Shen-2 field model. As Jake Ramsey, the geologist on the exploration team, admitted, such facts would not allow the projection of OWCs and suggested east-west compartmentalization at Shen. Nevertheless, Anadarko told the public that Shen3 '*validate[d] the company's geologic models*' and '*enabled the projection of oil-water contacts based on pressure data and reduced the uncertainty of the resource range.*'"

536. **Rebuttal to Merrill ¶ 81:** Merrill's conclusion that since "the water leg of Shen-3 lined up with Shen-1," Shen-3 pressures "could not be used to project OWCs across the field based on Anadarko's Shen-2 field model" is incorrect for several reasons.

537. First, the fact that Shen-1 water pressures line up with Shen-3 water pressures is not surprising and provides little information about the level of connectivity between the two wells. Water pressures in the basin have had tens of millions of years to equalize and a common water gradient at each well would not be unusual. The interpretation includes an east-west fault/weld that clearly exists between Shen-1 and Shen-2 and is interpreted to separate Shen-1 from Shen-3 and from Shen-2, respectively, concluding that Shen-1 and Shen-3 are not connected. Mr. Ramsey did not say that "such facts would not allow the projection of OWCs." In support of this, Plaintiffs cite to an email from Mr. Ramsey to Mr. Chandler, in which Mr. Ramsey wrote that Exploration might change their proposed Shen-4 location if "[t]he reservoir pressure data to be collected in the [Shen-3] well suggests no possible connection to [Shen-2] appraisal and/or they align themselves closely with the [Shen-1] discovery well… This would suggest east-west compartmentalization

along the lines of the possibility your team has been considering."[513] However, as Mr. Ramsey explained during his deposition, to properly compare Shen-1 and Shen-3 pressure data, you would have to compare "age-equivalent and depositionally similar sands."[514] He explained that although he did not say this in his email to Mr. Chandler, Mr. Chandler "would have been technically aware that comparing pressures in the Shen 3 to the Shen 1 or the Shen 3 to the Shen 2 explicitly meant comparing age-equivalent and depositionally similar sands."[515] Additionally, Mr. Ramsey also testified that even if Shen-1 and Shen-3 sands had similar gradients, they would have to have "the same pressure magnitude" to interpret them as connected,[516] and that if the sands did not have "the same pressure magnitude," the two could be interpreted "as being disconnected."[517]

538. Second, Merrill's statement that "the water leg of Shen-3" did not line up with Shen-2 makes no sense, as there was no water in the Shen-2 well with which to make a comparison.

539. Third, Merrill implies that assuming down-dip aquifer pressure connection between Shen-2 and Shen-3 somehow violates "Anadarko's Shen-2 field model." This is wrong. Such connectivity simply relies upon improved thickening and connectivity downdip—elements of the turbidite depositional model that Merrill had already made arguments to support.

540. Fourth, the north-south fault that was interpreted by teams between Shen-2 and Shen-3 is never drawn or interpreted to seal the aquifer into an east and west compartment, and without a clear indication that such a large isolating barrier exists, projection of OWCs through the common pressure-supported down-dip aquifer is clearly reasonable. Announcing to the public

---

[513] APC-00013451.

[514] Ramsey Dep. Tr. 43:22-23.

[515] *Id.* at 43:18-23.

[516] *Id.* at 45:5-9.

[517] *Id.* at 45:8-9.

that Shen-3 "enabled the projection of oil-water contacts based on pressure data and reduced the uncertainty of the resource range" was true in both regards.

541. Finally, Mr. Oudin testified that even though he did not think that Exploration's use of Shen-3 pressures to project OWCs gave the correct answer, he did support the use of Shen-3 pressure data: "It was one interpretation" and he "[did]n't disagree with the statement . . . [but] with it being the only statement."[518]

542. Merrill concludes that Anadarko somehow misled the public in saying that Shen-3 "validate[d] the company's geologic models." But Shen-3 validated the depositional turbidite model and proved the lateral continuity of depositional reservoirs, and provided confirmation of the lateral predictability of their properties. This is the definition of "validating the company's geologic model."

543. **Merrill ¶ 82:** "Shen-3 was positioned to test the position of the OWC but encountered no hydrocarbons. MDT pressure data were used to estimate OWCs in each sand. After Shen-3 found no hydrocarbons, the estimated OWC was placed at a subsea elevation of -30,510 ft across the entire structure. The lowest known oil (LKO) was about 1,105 ft (-29,045 ft subsea) above the projected OWC. The area above the projected OWC was used to calculate resource estimates, but as the development team geologist Paul Chandler observed, the *'o/w projection . . . is not definitive at al[l]' but would require a 'well to prove that' as 'Shen-3 has proved up very little.'* A sealing fault between the Shen-2 and Shen-3 wells would make such an OWC projection invalid. The development team recognized the potential effect of such a fault in 2014 and found evidence that the exploration team had as well, as Chip Oudin observed in an email to the development team: *'You know, I just got into the Exploration Seisworks project across*

[518] Oudin Dep. Tr. 125:23-126:21.

Shenandoah, and the main fault that potentially separates Shen-2 from the rest of the world (trending NW-SE, down-to-the-southwest, possibly intersecting Shen-2 at the bottom of the well) has already been mapped, at least twice. Someone needs to explain to me why it's never shown up on any Expl [Exploration] maps.' Paul Chandler responded: *'The smoking gun??'* The map presented in December 2014 (Fig. 13B) clearly shows this fault." (emphasis supplied by Merrill)

544. **Rebuttal to Merrill ¶ 82:** Merrill's assessment of Mr. Chandler's email is incomplete, as it fails to take into account Mr. Chandler's deposition testimony. Mr. Chandler testified that even though they did not find the OWC, he believed that they might be able to project an OWC up structure.[519] While Mr. Chandler's assessment that "a well would be required" to *prove* oil up-dip of Shen-3 is correct, as he confirmed in his testimony, he meant that "[i]t would take another well updip from the Shenandoah 3 to -- to possibly find an actual oil-water contact."[520]

545. While Merrill claims that a "sealing fault between the Shen-2 and Shen-3 wells would make such an OWC projection invalid," that is only if the fault seals all the way down to seal the aquifer; otherwise aquifer pressure would communicate from down-dip and make OWC projections valid. As discussed before, Anadarko Exploration was fully aware of the possibility of a north-south fault between Shen-2 and Shen-3. Prior to the drilling of Shen-3, Exploration chose to wait for additional data and greater consensus among the partnership. Post-Shen-3, a new seismic dataset, additional well control, a growing partner consensus, and a necessary remapping effort all pointed towards adding the fault to the maps. Just as Merrill notes, after Shen-3, "[t]he map presented in December 2014 clearly shows this fault."[521]

---

[519] Chandler Dep. Tr. 141:4-13.

[520] *Id.* at 144:2-4.

[521] Expert Report of Robert Merrill, ¶ 82.

546. **Merrill ¶ 83:** "Likewise, by January 2015, the development team had mapped an east-west trending fault just north of Shen-3. Figure 27 shows a seismic line running NNW to SSE through the Shen-3 location. Given the potential for this fault to seal, Shen-3 was not located effectively to be an injection well and provide pressure maintenance to up-dip production wells to the north, as was understood internally at the Company at the time."

547. **Rebuttal to Merrill ¶ 83:** The map that Merrill references here is an Anadarko Development map with the interpreted fault as he describes. However, Merrill neglects to point out that not a single partner map from this time frame has any such fault interpreted on it. Exploration's approach of seeking input from multiple independently derived interpretations before changing project's official maps is why this fault prudently does not show up on Exploration's maps.[522] By 2017, and with a new seismic dataset, Development had removed this fault from their maps.[523]

548. After Shen-3, the availability of new well and seismic data, along with a growing partner consensus, made it appropriate for Anadarko Exploration to add a north-south fault between Shen-2 and Shen-3. However, there was still no information as to whether that fault might be sealing or not. In response to both of these uncertainties, Exploration began to carry both a faulted and un-faulted set of maps, each with their own resource range. An inspection of partner maps shows that whether or not they carried the north-south fault, all partners continue to use oil-water contacts that show faults as non-sealing, unless well control and pressures proves otherwise.

549. Regarding Merrill's assertion that "Shen-3 was not located effectively" to be a possible water injector; this claim has nothing to do with whether or not this fault is present. Water

---

[522] *See, e.g.,* Marathon_004981 at slide 41.

[523] *See* APC-01286239 at slide 49.

injectors for pressure support provide that support over the entire pressure cell that they are in contact with. Merrill's statement would be true only if such a fault existed, the fault sealed every reservoir's up-dip oil column from its down-dip aquifer, and pressure support of those up-dip reservoirs was needed. As discussed in greater detail below in my rebuttal to Pittinger ¶ 111, the issue with Shen-3 being inappropriate as a water injector had nothing to do with the team's fault interpretation, and everything to do with the design and condition the well was left in.

550. **Merrill ¶ 85:** "Seismic interpretation differences were addressed in maps included in the McGrievy presentation dated May 13, 2015. Faults were noted in the Shen-3 BP-1 core, confirming potential compartmentalization."

551. **Rebuttal to Merrill ¶ 85:** Although not directly cited by Merrill, the differences in interpretive mapping both internally at Anadarko and with partners at Shenandoah reflect the level of uncertainty in the project, and poor quality of the seismic imaging that the interpreters were working with. Merrill's referencing of faults "noted in the Shen-3 BP-1 core, confirming potential compartmentalization" is an exaggeration of the faults identified either in core or with borehole imaging. One can see from the slide below that although faults can potentially be identified by the borehole imaging tool, the significance of that fault and any interpretation as to compartmentalization needs to rely on confirmation with seismic, which was not possible with the data at Shen-3. Therefore, no faults were placed on maps penetrated by Shen-3 and no specific compartments were identified from the well.

[redacted]

Figure 62 – A schematic of the types of geologic structures that can be determined with different tools. Core and borehole imaging tools are excellent in characterizing small scale geologic structures, but large-scale faulting requires confirmation via seismic mapping.[524]

5. Rebuttal to Pittinger Opinions re: Shen-3:

552. **Pittinger ¶ 85(a):** "Anadarko's claim that the MDT pressures obtained in the Shen-3 water leg enabled the projection of OWCs across the field was contradicted by internal data and based on the unrealistic assumption of hydraulic communication between Shen-2 and Shen-3 and the rest of the field. In my expert opinion, Shen-3 could not enable the projection of OWCs on the assumption of continuity across 2.3 miles and a fault to Shen-2 with any degree of confidence."

[524] ANACOP00020939 at slide 6.

553. **Rebuttal to Pittinger ¶ 85(a):** As discussed in detail above, it was reasonable to use Shen-3 to project OWCs. Pittinger does not cite to any internal data that proved that these two wells were not in pressure communication through a common down-dip aquifer or explain why it was an "unrealistic assumption" to conclude that they were. Pittinger's opinion is not shared by the dozens of technical experts across multiple companies working on the Shenandoah project or by me.

554. **Pittinger ¶ 85(b):** "Finding wet sands at Shen-3 reduced Anadarko's resource range, including estimated mean areal extent of the reservoir by 47%. The upside areal extent was even more negatively impacted, decreasing by 57%. A comparison of the June 2013 evaluation versus the post-Shen-3 evaluation in November 2014 is provided in Exhibit 47 and discussed in paragraphs 198-211. In my expert opinion, this decrease in areal extent post-Shen-3 was a significant, negative finding."

555. **Rebuttal to Pittinger ¶ 85(b):** It is true that the areas included in Anadarko's MMRA assessment of volumes from before Shen-3 to after Shen-3 were reduced for each reservoir based upon the negative finding that the area down-dip of Shen-3 was no longer prospective for hydrocarbons. However, it makes no sense to simply add these areas together, as each has a unique map associated with it. In addition, the dip of the reservoir beds significantly steepened, based upon Shen-3 data, and this would have reduced measures of areal extent without having the proportional impact on the net oil the reservoirs contain. Making judgments based simply on "numbers" without inspecting the underlying data would never be an accurate way to assess their applicability. The Anadarko Exploration team used their most recent structural and isopach maps incorporating all data to make their entries into the MMRA software.

556. **Pittinger ¶ 85(c):** "In my expert opinion, it is not possible for Anadarko's estimated oil in place as represented by Exploration's evaluations to have expanded as a result of findings from Shen-3. Based on a review of input files, Exploration's assumed recovery efficiency remained the same between their Pre-Shen-3 resource evaluation in June 2013 and their post Shen-3 evaluation in November 2014. Therefore the 23% volumetric reduction in recoverable volume is the direct result of a 23% reduction in oil in place with recovery efficiency remaining constant. Files containing assumptions are provided in Appendix C."

557. **Rebuttal to Pittinger ¶ 85(c):** In saying that "Anadarko's estimated oil in place . . . expanded," Pittinger cites a quote by Mr. Daniels published in Upstream Online: "They were also looking to establish an oil-water contact and to better understand the reservoir quality and potential recovery mechanism. 'If you look at the results, we really did all of that,' Daniels said: 'We had excellent lateral sand continuity, and the packages are all present. The oil-water contacts were not encountered in the well but based on the pressure data we were able to project those up. So, we got a much better handle on the oil in place, and that has expanded, with more confidence on it.'"[525] This is taken from a February 3, 2015 earnings call, in which Mr. Daniels described the results of Shen-3. Immediately before saying this, Mr. Daniels said, "We have excellent lateral sand continuity. The packages are all present, they are very well correlatable. They have expanded, so that model of expansion did work out. We had up to about 1,470 feet of gross sand section versus 1,000 feet that we had in the number 2 well. The oil/water contacts were not encountered in the well based on the pressure data we were able to project those up."[526] As Mr. Daniels reiterated during his deposition: "Yes, based on the pressure data, so we did get the better handle

[525] Daniels Dep. Ex. 379.

[526] Anadarko Petroleum Corporation Q4 2014 Earnings Call, Feb. 3, 2015 at 8.

based on the projection of the pressure data."[527] It is clear from the Anadarko team's assessment of volumes from before and after Shen-3 that the volumes reduced as a result of Shen-3, and Mr. Daniels was saying that their understanding of where OWCs might be located had been "expanded."

558. **Pittinger ¶ 85(d):** "In my expert opinion, Shen-3 supported the model of down-dip thickening, the corollary of which is up-dip thinning. However, under Leyendecker's management, the Exploration team assumed the exact opposite to their advantage in their post-Shen-3 resource evaluation by increasing the assumed total net pay across the field by 32% over their June 2013 study. While Shen-3 helped confirm the model of down-dip thickening, the team assumed the net pay would thicken up-dip of Shen-2 by an average of 17% in the mean case. If the Exploration team had assumed the same net pay model in their June 2013 evaluation consistent with up-dip thinning, the estimated mean resource would have decreased by a comparable amount as the area decrease of 47%."

559. **Rebuttal to Pittinger ¶ 85(d):** Pittinger provides no evidence for his assertion that the Exploration team assumed up-dip thinning following Shen-3 and his assumption that the net sand increase "required thickening up-dip of Shen-2, exactly counter to the crestal thinning trend" is incorrect. The net sand increase is predominantly because of proven lateral extent of net sand thickness away from Shen-2, proven by Shen-3, which had been assumed pre-Shen-3 to have thinned considerably to the east.

560. **Pittinger ¶ 13(b):** "Exploration's mean area for each horizon decreased by an average of 47%. With no other changes, the impact would have been to reduce the resource volume by almost half. Instead, Exploration increased the mean net pay by 32% and 16% thicker than

[527] Daniels Dep. Tr. 95:7-14.

Shen-2 net pay. In my expert opinion, Anadarko did not have a valid technical reason to increase the net pay estimate. Their increase required thickening up-dip of Shen-2, exactly counter to the crestal thinning trend observed in seismic lines since 2008. Shen-3 established down-dip thickening but did not establish up-dip thickening. The resulting post-Shen-3 mean resource estimate was revised downward from 1,200 MMBOE to 920 MMBOE. By contrast, Development reduced the mean resource estimate to a much lower 397 MMBOE, 57% less than Exploration's Post Shen-3 estimate and 67% smaller than their pre-Shen-3 volume."

561. **Rebuttal to Pittinger ¶ 13(b):** Pittinger's assumption that the net sand increase "required thickening up-dip of Shen-2, exactly counter to the crestal thinning trend" is in error. The table below depicts the values documented from APC's Rose & Associates MMRA and the actual well net oil pay/net sands seen in the Shen-2 and Shen-3 wells:

	Shen-2 Well	Shen-2 MMRA P90 sand	Shen-2 MMRA P10 sand	Shen-2 MMRA P90 pay	Shen-2 MMRA P50 pay	Shen-2 MMRA P10 pay	Shen-3 Well	Shen-3 MMRA P90 sand	Shen-3 MMRA P50 sand	Shen-3 MMRA P10 sand
UWLX 1&2	165	100	137	100	118	137	169	165	217	274
UWLX 3	240	165	205	165	185	205	274	240	269	300
LWLX A	160	136	185	136	155	176	209	175	187	200
LWLX B	139	118	160	118	135	152	117	125	132	140
LWLX C	166	141	190	141	151	161	47	125	137	150
LWLX D	38	20	100	20	52	95	158	80	90	100
LWLX E	94	80	110	80	92	105	176	100	135	175
Total	1002	760	1087	760	888	1031	1150	1010	1167	1339
	APC-00594667						Marathon_014736			
	slide #16						slide #13			

Table 12 – A comparison of Shen-2 and Shen-3 net sand and net pay values from wells and the P90/P50/P10 values entered and derived in the Rose & Associates MMRA spreadsheets for estimated risked volume calculation.[528]

562. Anadarko's Exploration team used isopach maps both before and after the drilling of Shen-3 to help make their net sand estimates, and these isopaches of both Upper and Lower

[528] APC-00594667 at slide 16; Marathon_014736 at slide 13.

CONFIDENTIAL

Wilcox sands both before and after the drilling of Shen-3 clearly show thinning of the sands up-dip as a standard feature.

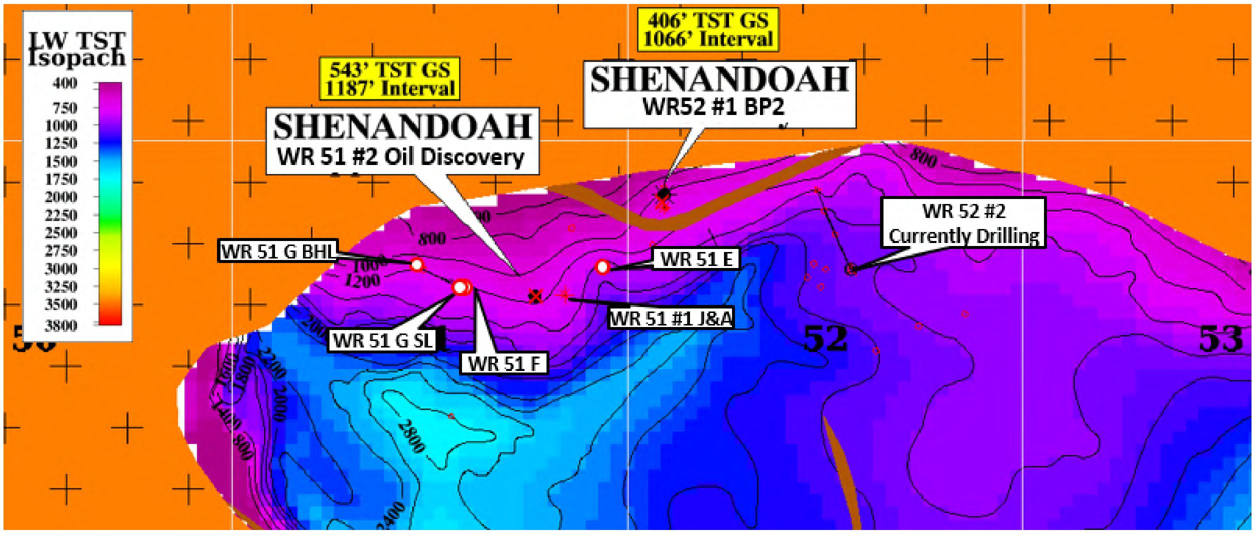


Figure 63 – Anadarko Exploration isopach of Lower Wilcox before drilling of Shen-3 well showing thinning of reservoir sands up-dip.[529]

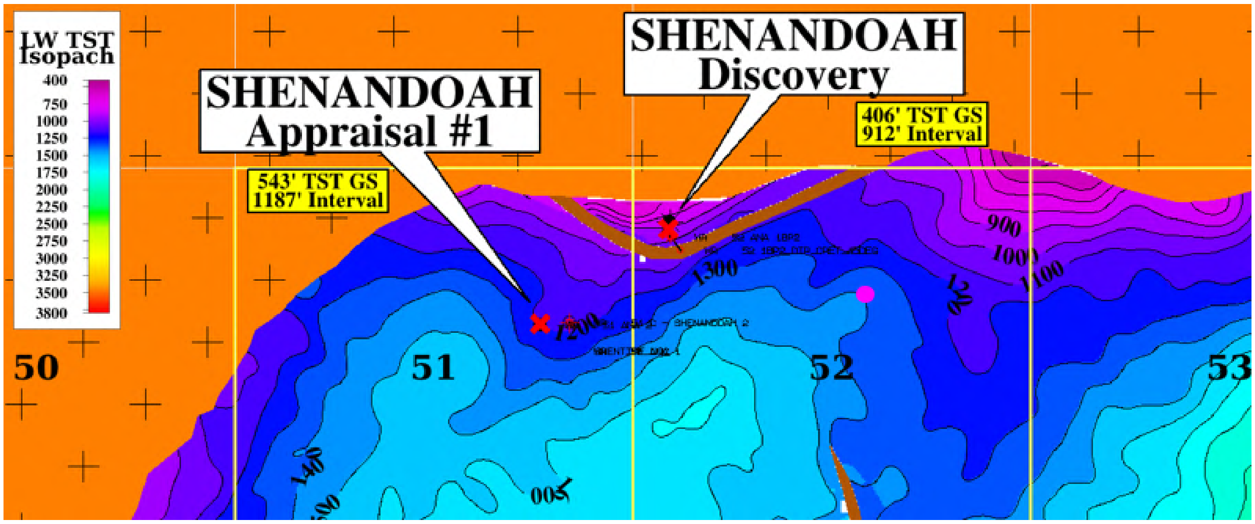


Figure 64 – Anadarko Exploration isopach Lower Wilcox after drilling of Shen-3 well showing continued thinning of reservoir sands up-dip. Changes in the thickness contouring represent updates in net sand laterally based upon well data.[530]

[529] APC-00633951 at slide 1.

[530] APC-00016754 at slide 83.

CONFIDENTIAL

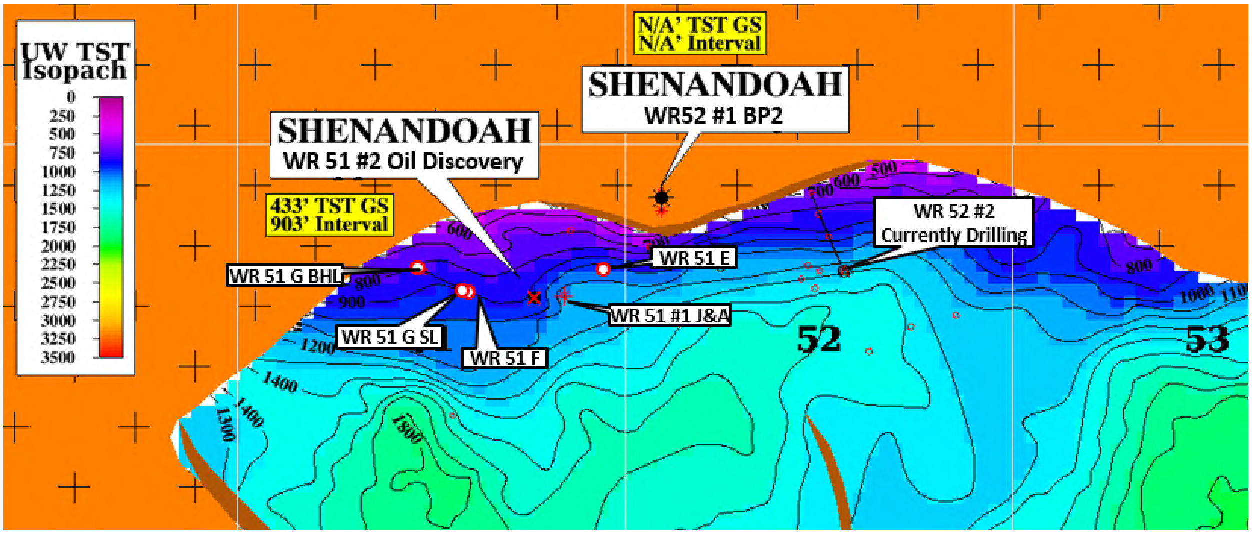


Figure 65 – Anadarko Exploration isopach of Upper Wilcox before drilling of Shen-3 well showing thinning of reservoir sands up-dip.[531]

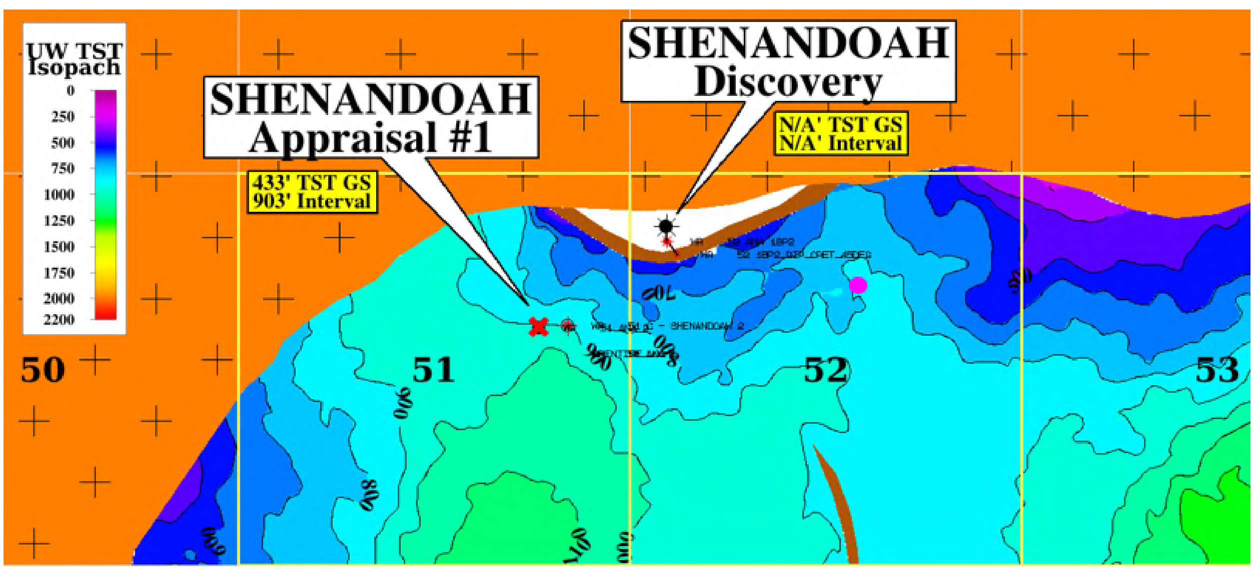


Figure 66 – Anadarko Exploration isopach Upper Wilcox after drilling of Shen-3 well showing continued thinning of reservoir sands up-dip. Changes in the thickness contouring represent updates in net sand laterally based upon well data.[532]

563. Isopach maps that *thin* up-dip are the basis of Anadarko's MMRA net sand inputs. This is clear from communications involving Mr. Ramsey confirming the technical procedure, an

[531] APC-00633951 at slide 2.

[532] APC-00016754 at slide 80.

example of which is: "Attached are 'scoping' TVT net pay #s that we can use in our MMRA update. I generated P90 & P10 net pay isopachs off of TVT interval isopachs that Beth created."[533]

564. Examining the net sand in the table above: First, in yellow, one can see that the Upper Wilcox "1 & 2" reservoir P90/P50/P10 net pay values for MMRA for Shen-2 are all much lower than the actual pay measured in the Shen-2 well. This likely resulted in an incorrect low estimate of the estimated volume at Shenandoah. The Shen-3 well measured slightly thicker sands at this level, and the APC Team then accounts for this by using the smaller Shen-2 measured net pay value as the P90 values in their post-Shen-3 MMRA calculations. This accounts for much of the 84% mean net pay increase for these reservoirs.

565. Second, in orange, one can see that the Upper Wilcox "3" reservoir P90/P50/P10 net pay values for MMRA for Shen-2 are also all much lower than the actual pay measured in the Shen-2 well. This also resulted in an incorrect low estimate of the estimated volume at Shenandoah. The Shen-3 well again measured slightly thicker sands at this level, and the APC Team again accounts for this by using the smaller Shen-2 measured net pay value as the P90 values in their post-Shen-3 MMRA calculations. This accounts for the much of the 46% mean net pay increase for this reservoir.

566. Third, in blue, one can see a significant reduction in the net sand at the Lower Wilcox "C" sand between Shen-2 and Shen-3 wells (from 166 feet to 47 feet). Accordingly, the APC team reduces their P90 values from 141 feet to 125 feet for this sand resulting in the 9% reduction in mean net pay for this reservoir.

567. Fourth, in green, one can see that there was a significant increase in the net sand at the Lower Wilcox "D" sand between Shen-2 and Shen-3 wells (from 38 feet to 158 feet).

[533] APC-00617367.

Accordingly, the APC team significantly increase their P90 estimate from 20 feet to 80 feet while slightly increasing their P10 estimate from 95 feet to 100 feet, resulting in a significant 73% increase in estimated mean net pay values for this reservoir.

568. The net result of this analysis is that the Anadarko team members likely were conservative in their estimation of the lateral extension of net pay in at least three of the reservoirs after the Shen-2 well. The thickening of the sands measured in Shen-3 drove updates in the team's net sand mapping. The Anadarko team generated and used net reservoir sand isopach maps to help drive the values used for P90/P10 net oil pay in their MMRA estimated volume calculation both before and after the Shen-3 well, and the increase and decrease in values appear to be consistent with changes dictated from Shen-3 well results. Increases in estimated net pay after Shen-3, which encountered generally thicker sands than were seen at Shen-2, drove mapped net pay estimate increases in some sands.

569. I am not aware of any evidence that the APC team embraced or proposed a depositional model where the sands thickened up-dip. Increases in net pay estimates after Shen-3 are likely related to different and improved isopach maps created after the Shen-3 well, which are based upon improved mapping and additional well control.

570. **Pittinger ¶ 85(e):** "A discussion of Shen-3's sand quality is incomplete without mentioning that the Shen-3 porosity and permeability were much lower than the previous two wells. Based on Exhibit 50, Shen-3 porosity was 2.3 percentage points lower than Shen-2 and 4.6 points lower than Shen-1. Permeability in Shen-3 was 11 mD, 72% lower than Shen-2 and 97% lower than Shen-1. In my expert opinion, Shen-3 sand quality was substantially worse than in the first two wells and should not have been considered excellent quality."

571. **Rebuttal to Pittinger ¶ 85(e):** The relative measure of "good quality" Wilcox sands at Shenandoah are based upon a relative comparison to other lower Tertiary discoveries in the Deepwater Gulf of Mexico. **Table 2**, discussed in Section VI.C.1, above, compares Shen-2 reservoir quality values to those from other Wilcox fields. Reservoir sand quality varies somewhat from sand to sand and depends upon depth below the seafloor, especially values in permeability which carry a significant range. Shen-2 was characterized at Anadarko as having "High Quality Reservoir Sands (19 – 22% Poro & 25 – 80 mD Perm)."[534]

572. In the same presentation, Shen-3 was also characterized as having "High Quality Reservoir Sands in Aquifer (17 – 19% Poro)."[535] The differences between Shen-2 and Shen-3 excellent reservoir quality (porosity and permeability) that Pittinger refers to are insignificant when compared to the poorer reservoir quality of other Wilcox reservoirs being developed in the deepwater Gulf of Mexico. Additionally, the lower value of permeability in the water filled zones is not unusual in deepwater, as the higher temperatures typically cause quartz overgrowths diagenesis to occur on the water-saturated sand grains. Oil-saturated rock prevents this process from proceeding giving rise to higher permeabilities than seen in their down-dip wet sand equivalents.

573. **Pittinger ¶ 85(f):** "Shen-3 could not be used as a water injector well and had no future utility."

574. **Rebuttal to Pittinger ¶ 85(f):** As discussed in greater detail below in my rebuttal to Pittinger ¶ 111, the future utility of Shen-3 as a possible injector well was not initially settled, and was partially dependent upon technology available at the time.

---

[534] APC-00002204 at -206.

[535] APC-00002204 at -207.

575. **Pittinger ¶ 86:** "In short, the results of Shen-3 rendered Shen unlikely to be commercial. The evidence will be discussed further below."

576. **Rebuttal to Pittinger ¶ 86:** This claim is untrue, as Shen-3 did not provide the necessary information to definitively project the commerciality of Shenandoah. Significant uncertainties remained; while some type of commercial development appeared likely, the extent was indeterminable until more information was made available. The partners elected to spend additional resources for continued evaluation and appraisal to reduce the range of uncertainties. Additionally, the fact that Navitas and Beacon have created, and are currently executing, a development plan for Shenandoah that does in fact define a commercial development belies Pittinger's opinion.

577. **Pittinger ¶ 87:** "McGrievy writes to Darrell Hollek that the depths of OWCs cannot be determined with confidence from the Shen-3 MDT data. Exploration's projection of OWCs was based on the assumption of hydraulic continuity between Shen-2 and Shen-3."

578. **Rebuttal to Pittinger ¶ 87:** The email McGrievy writes also clearly states: "The bottomline, in our opinion, with the current data set, is that we can *neither prove or disprove an OWC contact* as the results of the [Shen-3] data are not convincingly definitive in any scenario and we cannot sanction with this potentially ambiguous data set despite the level of optimism from exploration. We still *need another well in this FB* [fault block] to prove the column height"[536] A projection of pressures to estimate an OWC never *proves or disproves* its existence—this is why it is always referred to as an "estimate." In this case, it is the "best estimate" as any other estimate carries a much larger degree of uncertainty. Since this estimate falls in between the LKO and HKW, it provides a reasonable mid-case estimate and was used as such by Anadarko Exploration

[536] APC-00147455 at -455 (emphasis added).

and each of its partners. Anadarko's Development team soon began using this projection on its maps and continued to do so for the extent of the appraisal program. Mr. McGrievy's recognition that the appraisal program would "still need another well in this FB to prove the column height" correctly identifies the reason for the Shen-6 appraisal well.

579. **Pittinger ¶ 90:** "McGrievy wrote on November 21, 2014 that results from Shen-3 MDT pressures did not confirm Exploration's interpretation that Shen-2 and Shen-3 are in communication and that Shen-3 identified the depths of OWCs down-dip of Shen-2.

> 'From a development perspective, I think it's important to point out that the **learnings from Shen 3 appear to be inconclusive** with no clear evidence of HC's in the well and pressure data which cannot confirm nor refute any of the three potential outcomes (communication with Shen 2 – large east container, communication with Shen 1 – small east container, or perhaps complete isolation from either penetration of unknown size). Given the current level of uncertainty in sizing the east side, unfortunately we cannot use this data to definitively add needed barrels to our sanction effort.'"

580. **Rebuttal to Pittinger ¶ 90:** It was well-known that the projection was only an "estimate." Mr. McGrievy speaks "[f]rom a development perspective" and thus concluded that the data could not be used to "definitively add needed barrels to our sanction effort." In other words, the data could not be used to confirm oil needed for the [minimum economic field size ("MEFS")]. The data could still be used to project OWCs and to guide future appraisal locations, including Shen-6. In fact, Shen-6 was located in order to define which of Mr. McGrievy's three options corresponded to subsurface reality.

581. **Pittinger ¶ 88:** "As shown in Exhibit 10, COP had already mapped several possible faults that would likely separate Shen-2 and Shen-3, making Anadarko Exploration's structural continuity model inaccurate."

582. **Rebuttal to Pittinger ¶ 88:** Pittinger suggests that Anadarko's partner ConocoPhillips did not make similar OWC projections for Shen-2 based upon pressures from

Shen-3 because of their mapped faults. However, ConocoPhillips abandoned this map and soon eliminated all of the east-west faults from their interpretations. In addition, ConocoPhillips soon similarly used Shen-3 pressures to estimate OWCs at Shen-2 and others continued to do so on future identified fault blocks.

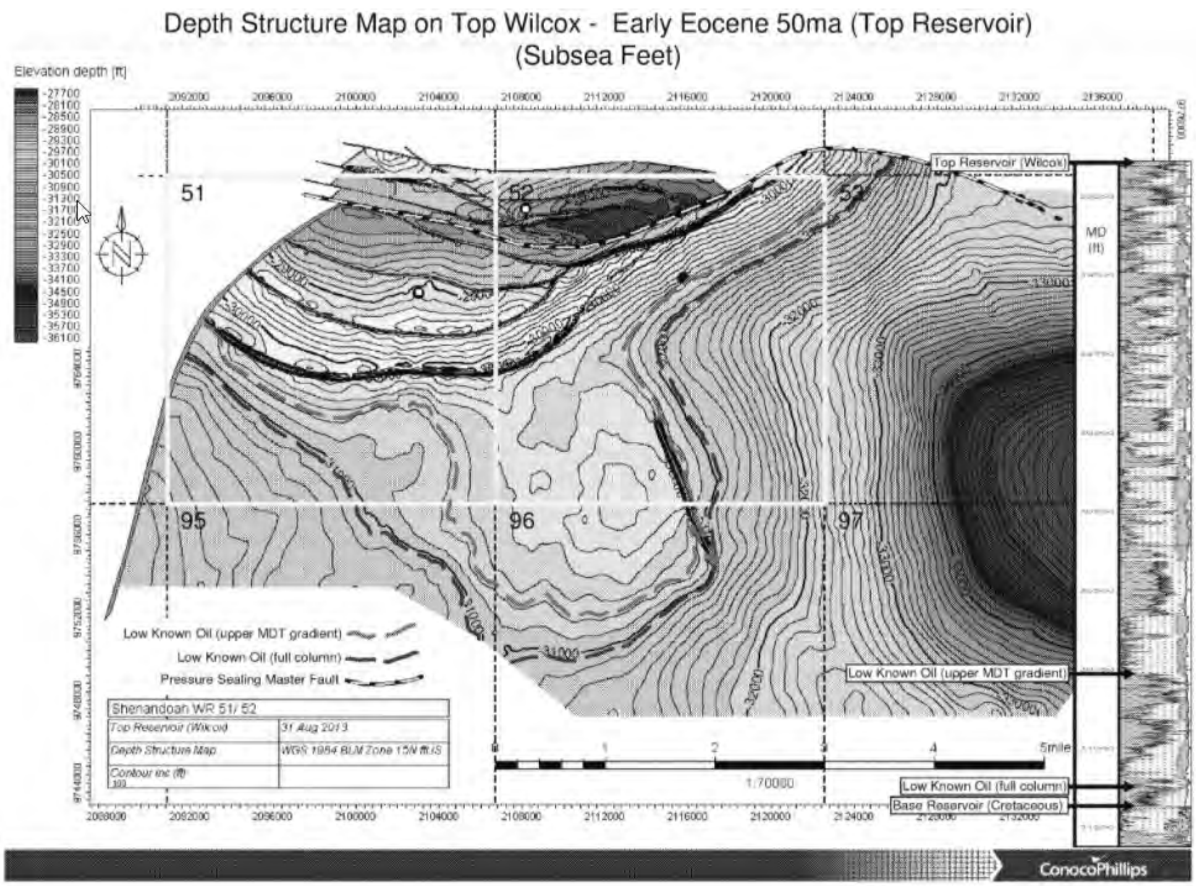


Figure 67 – Early ConocoPhillips structure map showing extensive east-west faulting shown by Pittinger as Exhibit 10.[537] ConocoPhillips soon replaced this map with one showing no east-west faulting and interpreted four north-south faults instead.[538]

583. **Pittinger ¶ 89:** "On November 17, 2014, McGrievy wrote to his manager Hollek that Exploration continued to adhere to an unfaulted structural model and that agreement on the

---

537 Expert Report of Lyndon Pittinger, ¶ 55, Ex. 10

538 Expert Report of Lyndon Pittinger, ¶ 104, Ex. 21.

issue would not occur quickly. McGrievy also laments that it is hard to meet with partners with 'a straight face' without acknowledging the key role that faulting has in appraising the discovery, something all the partners and Anadarko development agreed on.

> 'We also have to come to terms with an internal map that both EXP and DEV can support as **they still show no acknowledgment of faulting**; this, however, will not be a deliverable for some time. It's hard to go to partner meetings with a straight face and not acknowledge faulting when all of our partners externally share the same concerns.'" (emphasis supplied by Pittinger).

584. **Rebuttal to Pittinger ¶ 89:** Anadarko, including Exploration, and the partners agreed that faulting was an uncertainty to be explored during the appraisal. Pittinger does not include the first part of Mr. McGrievy's email, which says: "If this is the case (inviting Jim), since we have workshops on Tuesday and Wednesday of this week, my preference would be to postpone the meeting until the early in the 2nd week of December (*i.e.*, Tuesday, December 9th) since some of the team is out the entirety of next week. This will allow us time to incorporate the presentation materials shown to you two weeks ago with the recent findings on the Shen 3 and a definitive go-forward plan for Shen 3, which should be in process of by-passing by then."[539] This was an ongoing process and Anadarko did not have the complete information from Shen-3; during internal meetings around this time, the Anadarko teams discussed mapping interpretations and well results internally. Less than a month later, Anadarko Exploration presented to the partners a map with a clear potential north-south fault.[540]

585. **Pittinger ¶¶ 91-93:** "Dan Smallwood, COP's GOM Deepwater Asset Development Manager, commented regarding Shen-3:

[539] APC-00147547.

[540] APC-01678462 at slide 9, 51–52, 73–79.

> 'The wet results of the WR52-2 well failed to narrow uncertainties for COP. . . . Combined these uncertainties yield a current interpretation which remains far from enabling us to proceed with any size/phase development. COP believes there may be well locations which could reduce out interpretations below any minimum field size needed for even a small phase development – and thus a clear walk way outcome.' . . . Smallwood's email to Hollek indicated dissatisfaction with COP's inability to influence decisions on appraisal well locations. 'Prior to today, the answer is basically no in regards to this next appraisal well. . . . Our Shenandoah Lead contacted Tim Trautman today seeking information on what APC Exploration was considering and we were sent back APC's preferences for a x-y location. That location does not meet our desired objectives.'"

586. **Rebuttal to Pittinger ¶¶ 91-93:** Pittinger discusses the relationship between Anadarko and ConocoPhillips. He characterizes the tension between Anadarko Exploration, which was executing its company's strategy to test the east-west extremes of the Shenandoah accumulation, and ConocoPhillips, which wanted to first prove a Minimum Economic Field Size (MEFS) to determine whether they would continue to participate. However, a partner's contribution, influence, and input in decisions and activities is well defined in their partnership agreement. As the operator, it was in Anadarko's best interests to follow its company strategy for appraising Shenandoah, and, within the terms of the Partnership Agreement, would be expected to do exactly that. Ms. Frye also testified about the objectives of Anadarko Exploration where "Exploration goals were around finding new resources."[541]

587. **Pittinger ¶ 94:** "Paul Chandler, a geologist on the Development team, made a statement about targeting the next appraisal well, Shen-4, that demonstrated the impact of faulting on determining the location of future wells. Chandler cited the potential risk of faulting higher in the structure.

> Chandler to Ramsey email: 'My tendency anyway would be to avoid being too high on structure as I fear an increase likelihood of more potentially faulted section so again I think a straight hole here might be just fine. I also agree with you that as soon as you guys and our development team gets a finalized structure map

[541] Frye Dep. Tr. 139:1-17.

> completed on our key Wilcox horizons we should compare to make sure a straight hole at this F location is OK.'"

588. **Rebuttal to Pittinger ¶ 94:** Pittinger quotes an email from Mr. Chandler to Mr. Ramsey but makes no conclusions about it. However, the email is important in that it confirms that faulting is one of the key risks of drilling far up-dip near salt: "*increase likelihood of more potentially faulted section*." This warning was in reference to the upcoming Shen-4 well—where Anadarko encountered faulting and drilling issues. The evidence of faulting of the sediments near the salt walls does not necessarily serve as an analogue for the existence or character of faulting away from these types of locations.

589. **Pittinger ¶¶ 95-96:** "Oudin expressed concern that north-south faults had been mapped by Exploration at least twice already, indicating that faulting would potentially isolate Shen-2 but remain excluded from their current structural map. Yet these north-south faults are considered very seriously by the Development Team and partners. . . .

> Oudin to Chandler email . . . : 'You know, I just got into the Exploration Seisworks project across Shenandoah, and the main fault that potentially separates Shen-2 from the rest of the world (trending NW-SE, down-to-the-southwest, possibly intersecting Shen-2 at the bottom of the well) has already been mapped, at least twice. Someone needs to explain to me why it's never shown up on any Expl maps. We should have a good time next week going over what is and what isn't significant."

590. "In a sarcastic response, Oudin expressed doubt that these faults were recently mapped. This indicates that Exploration's knowledge of the possible existence of these faults might date back further into the time period where Exploration advocated strongly for an unfaulted structure map."

> "Oudin to Chandler Email: 'Both versions were probably mapped in the past week, right??? Although if I really wanted to be a pain in the a--, I could find a date-stamp for those faults and determine when they were created.'"

> "Chandler responded: *'The smoking gun??'*"

591. **Rebuttal to Pittinger ¶¶ 95-96:** The emails Pittinger references are from November 25, 2014, a time when Shen-3 well operations were still underway, before Shen-3ST was even begun, and when very preliminary results were just being assembled. Pittinger claims that the email shows "serious concerns about north-south faulting." Again, it is important to note that these interpretations that Mr. Oudin are referencing were pre-Shen-3 interpretations and that exploration updated their structure maps within the next month with the recent Shen-3 results and produced an official map that includes this fault.[542] When Pittinger concludes that this "indicates that Exploration's knowledge of the possible existence of these faults might date back further into the time period where Exploration advocated strongly for an unfaulted structure map," he offers agreement that exploration was not "ignoring" or "unaware" of potential faulting at Shenandoah. As discussed above in my rebuttal to Merrill ¶ 82, Anadarko Exploration was fully aware of the possibility of a north-south fault between Shen-2 and Shen-3, but was unable to reach consensus of where to locate it consistent with partners' and internal teams' interpretations. Prior to the drilling of Shen-3, Exploration chose to wait for additional data. Following Shen-3, a new seismic dataset that necessitated a remapping effort, additional well control, and a growing partner consensus all worked in favor of adding the fault to the maps.

592. **Pittinger ¶ 97:** "Leyendecker expressed an unwillingness to change the targeted location of Shen-4 and asserted that other maps would not be considered in targeting the well because they were based on fundamentally flawed geologic and geophysical principles. No specific details were provided to support his claim. In my experience, given the amount of time Leyendecker spent with the maps, a mere day, relative to the skilled and interdisciplinary team's months, this claim was baseless."

---

[542] APC-00852630.

593. **Rebuttal to Pittinger ¶ 97:** Pittinger refers to an email in which Mr. Leyendecker and several others discussed a timeline for working sessions between Anadarko Exploration and Development to reconcile the differences between their maps, in order to ultimately decide on the path forward regarding Shen-4.[543] Mr. Leyendecker had reviewed alternative internal maps and partner maps for a final decision on the Shen-4 location. After Tim Trautman stated that they would "need to give our drillers and regulatory folks ample time to re-group if we decide to change the location,"[544] Mr. Leyendecker decided that the evidence to move it was not strong enough, stating: "We are not likely to change the location. I am willing to listen to others b[ut] after spending most all of yesterday reviewing the alternative maps I am not inclined to base our next well decision on maps that violate basic fundamental geologic and geophysical principals."[545] Pittinger is wrong when he claims that "[n]o specific details were provided to support his claim." Mr. Leyendecker, who had spent significant time working on the project, made clear that he had reviewed the maps and did not agree with the technical work.[546] Mr. Leyendecker further outlined the basis for his decision in a draft note to Mr. Hollek:

> "I spent most of Tuesday reviewing your team's geologic interpretation (map) and COP's maps that were reviewed at the joint team meeting on September 17th. I found problems with both sets of maps. The maps had very basic and fundamental geologic errors which I feel are unacceptable for use in planning any further investment or well activity. The map I reviewed was made on a horizon above the main reservoirs, not on anyone of the sands encountered in the current well. It did not appear the map had been accurately corrected for dip. I observed multiple faults mapped with no throw, a common mistake usually made by mappers with limited geologic thought and experience relying on computer contouring. I observed faults where there was no evidence of faults using best practices and the most current advanced (seismic processing) technology. I observed faults in wells drilled that did not encounter displaced or missing section on the well (i.e., the well did not cut

[543] APC-00148076 at -076.

[544] *Id.*

[545] *Id.*

[546] *Id.* at -076, -077.

> a fault). I saw 200' to 500' (fault) displacements on COP's map and cannot find anything in the data with that maximum amount of displacement using the same most current processed seismic data. Bottom line, my feeling is this is poor quality work. I would not base our next recommendation and well location using this quality of product. Also, Bob is willing to go through these interpretations (maps) line-by-line if they want."[547]

594. Pittinger's accusations that Mr. Leyendecker was unwilling "to change the targeted location of Shen-4 and asserted that other maps would not be considered in targeting the well" is a judgment that is completely unsupported. There is no basis to say that Mr. Leyendecker spent an inadequate time with the teams reviewing their maps, and his criticism that Mr. Leyendecker's opinion is "baseless" is unfounded.

595. **Pittinger ¶ 98:** "Notes from a joint meeting between the Exploration and Development teams on December 1, 2014 and December 2, 2014 indicate that the technical teams agreed that a north-south fault divided the field into an east and west component. Compartmentalization from faulting was listed as a key uncertainty in selecting appraisal well locations. Finally, both teams agreed that the P90 resource estimate was too high because faulting could affect the lateral extent of the oil accumulation, especially to the east. This meeting is significant because it resulted in some areas of agreement between the Exploration and Development technical teams despite Leyendecker's vehement opposition to a faulted model."

596. **Rebuttal to Pittinger ¶ 98:** These notes are in conflict with many of Pittinger's own claims. Among other issues, the notes indicate that:

- "Exploration is recognizing only high confidence faults. Development sees potential for additional faulting. Exploration is looking for more confirmation of faulting (imaging/well control) . . ."
- "Development team [is] production time line driven . . ."

[547] APC-00617479.

- "Development wants lower risk more conservative approach – minimum for commerciality (phased production)."[548]

597. This supports the view that Exploration continuously recognized the possibility of faulting; they simply required a higher level of confidence before placing faults on their maps. It also highlights that Development was more "time line driven" in their approach to appraisal, and that Anadarko's Exploration and Development teams had different strategies and objectives in the appraisal program. While Pittinger claims that "both teams agreed that the P90 resource estimate was too high because faulting could affect the lateral extent of the oil accumulation, especially to the east," the joint teams actually claimed that the "[c]urrent P90 is too high given potential for faulting and high level of uncertainty."[549] Pittinger's conclusion that these joint agreements were reached "despite Leyendecker's vehement opposition to a faulted model" is unsupported by the evidence.

598. **Pittinger ¶¶ 99-102:** "An important email chain shows Exploration proceeding based on the unfaulted model despite agreeing to the existence of a north south fault at the December workshop described above. Hollek wrote to McGrievy on December 1, 2014 expressing disappointment that Exploration announced a recommended location for Shen-4 based on an unfaulted model as follows:

> Hollek to McGrievy email dated 12/1/14: 'I am disappointed we did not work through the joint meetings first.'"

599. "In the same email chain, McGrievy responds by saying that he thought Trautman had agreed to work through differences for an interpretation both Exploration and Development

[548] APC-00617572 at -572.

[549] *Id.*

could support. He did not understand why a recommended location was publicized to partners when it was still internally debated.

> McGrievy emailed Hollek on 12/1/14: 'I talked with Tim Trautman immediately after leaving your office this morning and I thought I had an agreement with Tim that the technical teams would work through the differences in interpretation and develop one or two outcomes that both teams could support. Furthermore, it was my understanding that the results would be shared assuming that we came to a single collective interpretation. Chip, Paul and Paul Schlirf did meet today with exploration (Jake and Beth) to begin the mapping reconciliation process and have plans to continue tomorrow working together. I don't understand why we publicized the recommended location in the e-mail already when I thought that it was still debatable, internally. Obviously, This will not sit well with COPC and probably Cobalt. I was not copied on the meeting proposal to the Shenandoah partnership Land contingent but only forwarded as an FYI.'"

600. "The final email in the chain from McGrievy to Hollek on December 2, 2014 states that McGrievy's preference would be not to attend the partner meeting, objecting to showing only a case with '*little or no separation via faulting.*' McGrievy states that '*it will be difficult for me and quite frankly* ***ethically questionable to openly support their current maps*** *which show no discontinuities.*' To McGrievy, he appears to raise his concerns about showing an unfaulted structure not as a technical issue but as an ethical issue.

> McGrievy email to Hollek dated 12/2/14: 'Darrell, not to beat a dead horse here, but after thinking about it (provided that you don't oppose the idea), my preference would be not to attend the partnership meeting next Wednesday with the exploration team if they appear defiant in working with us to develop a map that indicates acknowledgment of faulting that would suggest potential separation from their currently proposed F location. Unless they (exploration) can convince us over the next couple of days that there's **little or no separation via faulting**, it will be difficult for me and quite frankly **ethically questionable to openly support their current maps** which show no discontinuities. I was never sent an official invitation which may imply that they prefer I not be there in the first place.'" (emphasis supplied by Pittinger)

601. "An email quoted below from Kleckner to McGrievy showed senior management's awareness of Development's identification of faults and its impact on appraisal strategy – where and in what order to drill the wells.

> 'In looking further at the maps I can see where this argument can be turned to support the B location first if the E-W trending fault that separates B from S2 is not present. Our map shows a substantial fault separating the two locations, does exploration have the same fault mapped? If not I can see their argument for going up dip and proving up this area if it is continuous.'"

602. **Rebuttal to Pittinger ¶¶ 99-102:** These emails were all in lead up to the December 10, 2014 Partners' Meeting, which would include a discussion of the Shen-4 appraisal well location. Pittinger claims that these emails show "Exploration proceeding based on the unfaulted model despite agreeing to the existence of a north south fault at the December workshop described above." This is a complete misinterpretation of the facts as the north-south fault agreed upon by the teams was between Shen-2 and Shen-3, and the fault(s) that Mr. McGrievy was referring to were those located to the west near the Shen-F location, one fault of which was oriented east-west. Because Exploration had not mapped these faults, their proposed location made sense as it could test if the area was continuous.

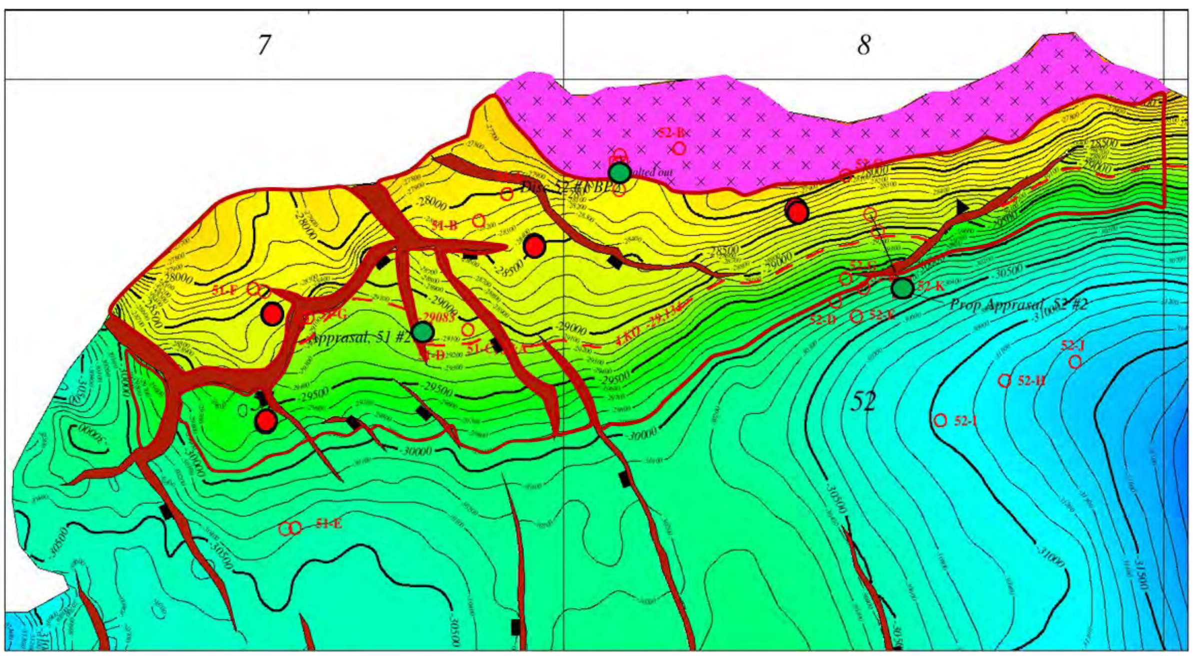


Figure 68 – Anadarko's Development team mapping indicating significant interpreted faulting and showing both the proposed Shen-F location (drilled as Shen-4) and the Shen-B location.

Development was concerned about east-west faulting down-dip of the "F" location. Development was wrong as this fault did not exist and this whole up-dip region was salt.[550]

603. One can see from the post-Shen-3 development structure map, shown in the Figure above, that McGrievy was referring to the down-dip fault from the Shen-F location. However, Development's faulting proved to be in error, as the original wellbore at Shen-4 ("Shen-4 OH") proved this area to be salt. Exploration's decision not to put speculative faults on their maps proved accurate.

604. **Pittinger ¶¶ 103-104:** "A partner meeting was held on December 10, 2014, addressing the Shenandoah appraisal strategy. Anadarko presented a structure map with only one fault between Shen-2 and Shen-3, as shown in Exhibit 20. This map by exploration was an early display of their recognition of a north-south trending fault located near Shen-3. . . . In contrast, COP presented a much more faulted structural picture in Exhibit 21, below. Instead, COP's structural interpretation included four N-S trending faults shown below, with two faults potentially separating Shen-2 and Shen-3."

605. **Rebuttal to Pittinger ¶¶ 103-104:** While Pittinger recognized that Anadarko Exploration presented a map with a north-south fault, he continues to suggest that the Exploration team "ignored faulting" by contrasting their map, with one fault interpreted, to ConocoPhillips' map, that showed four interpreted faults. However, ConocoPhillips' map also showed no faulting in the proposed area for drilling Shen-4 ST, which later proved incorrect, as well as faulting to the east that was moved over time. Later appraisal drilling proved the speculative nature of some of these other "mapped faults," which supports Exploration's approach of only putting faults on its maps when there was compelling evidence to do so.

[550] APC-00147987 at slide 6.

606. **Pittinger ¶ 105: "**At this meeting, Venari presented a summary slide: '*Current seismic interpretation indicates that faulting may compartmentalize the Shenandoah field*.' Partner Cobalt includes 'Reservoir Segmentation by Faults' as one of its key uncertainties. At this stage of the appraisal of the Shen discovery, most partners plus Anadarko's Development team agreed that compartmentalization from faulting was a major risk to the project."

607. **Rebuttal to Pittinger ¶ 105:** Pittinger again overstates this risk of faulting. The partner presentations that he cites support the conclusion that faulting was a risk and uncertainty, which the appraisal process was designed to test. At this stage, the partners lacked sufficient understanding to determine the extent of any such faulting.

608. **Pittinger ¶ 106:** "Hollek updated Kleckner in an email that partners were displeased with how Exploration was not working with partners on targeting Shen-4 to provide the most amount of information. COP also indicated that Development needed to be present in future partner meetings targeting wells, apparently expressing frustration in Exploration's performance."

609. **Rebuttal to Pittinger ¶ 106:** Pittinger implies that differences of opinion between Anadarko Exploration and ConocoPhillips on the location of the Shen-4 appraisal well was an issue. But, as explained by Mr. Leyendecker's in his deposition: "we were frustrated with ConocoPhillips I think, the lack of communication on a few things as we discussed earlier in the testimony. But -- and of course you saw my opinion that I didn't think very highly of their contributions to the -- the project. My experience with them was they didn't have a lot of experience in the deepwater Gulf of Mexico, and what little experience they had were commercial failures."[551] Also, Mr. Leyendecker exhibited his displeasure with Anadarko's Development team in a draft email to Mr. Hollek that stated:

[551] Leyendecker Dep. Tr. 221:6-14.

> "We have regrettably been put in a most awkward position with respect to at least one of the partners and our ability to provide Exploration leadership, collaboration and technical expertise - some of the skills and traits we are well known for throughout industry and the GOM. I have not heard from the other partners but anticipate this has enabled behaviors to once again try to divide and conquer APC. Unfortunately, this time it has been initiated from within our own ranks. I struggle to understand why our core values and behaviors were violated - open communication, honesty, integrity and trust. Most disturbing is Pat representing APCs position with no regard to advising, communicating or collaborating with the Exploration team responsible for the appraisal [location of Shen-4]. The Exploration team was never made aware of your team's recommendation for an alternative appraisal location until they were ambushed by COP. A most unfortunate way of communication planted with seeds from within APC while the Exploration team has consistently been open and collaborative at every step of the discovery and appraisal process."[552]

610. Mr. Leyendecker further indicated that "By the way, Smallwood's [at ConocoPhillips] comment about us [Anadarko] not asking for their input on the locations and getting back with them is pure fiction. Land advised me that we sent them the EP locations requesting feedback and received nothing from them."[553]

611. **Pittinger ¶ 107:** "Wilkens prepared a file listing eight zones in the Shen-3BP1 core that showed deformation bands, providing strong evidence of faulting within the well. Deformation bands can signify small faults with very small displacements. Within porous sandstone, stress can deform the rock to shift the packing of the sand grains and crush the sand grains, resulting in much lower permeability and porosity. Hence, deformation bands do not require large displacements along a fault to form a barrier or restriction to flow."

612. **Rebuttal to Pittinger ¶ 107:** While Pittinger claims that stress in the porous sandstone can result in "much lower permeability and porosity," Pittinger does not offer any evidence or citations for this claim. More importantly, Pittinger also fails to demonstrate that this

[552] APC-00617479.

[553] *Id.*

occurred or had been identified at Shenandoah, or any other Deepwater Gulf of Mexico Lower Tertiary discovery.

613. **Pittinger ¶ 108:** "Following a Development team discussion of geologic and geophysical concerns, Oudin states as follows that faulting was his primary concern:"

> "Compartmentalization – primarily faulting, but also evidence from wells in basin for variable sand thicknesses (stratigraphic pinchouts?). Seismic evidence for faulting away from structure, also evidence that Yucatan deep structure is faulted; what is likelihood that faults extend onto and segment structure?"

614. **Rebuttal to Pittinger ¶ 108:** While Pittinger claims faulting was Oudin's "primary concern," Oudin notes that his concern was "compartmentalization," which included "primarily faulting" but also "evidence . . . for variable sand thickness." Oudin, like Exploration and the rest of the partners, recognized the risk of faulting, but did not have sufficient information to determine the extent of any such faulting at Shenandoah. Oudin's list of "concerns" also includes, among other things: (1) the "Discovery well and relationship to Shenandoah accumulation," noting the risk of faults "not seen on seismic . . . that might segment reservoirs," (2) salt above the Lower Wilcox reservoirs—"what does this represent"—and (3) if the current seismic imaging data was "sufficient to define structure and reservoir."[554]

615. **Pittinger ¶ 109:** "McGrievy summarizes to Oudin in an email the results of a meeting on Shen-4 with Daniels, his direct reports, and Kleckner. At that meeting, some VPs expressed concern that Exploration's P99 was too large. In my opinion, this concern was salient given the known risk of fault-related compartmentalization potentially limiting the eastern extent of the oil accumulation."

[554] APC-00020023.

616. **Rebuttal to Pittinger ¶ 109:** Importantly, the email to which Pittinger points notes that "Chris Camden also talked about the OWC contacts being about ~200 ft updip of the Shen 3 location as per their interpretation but he did acknowledge that there could be multiple interpretations and that his interpretation is not absolute."[555] In other words, Mr. Camden noted that Exploration had one interpretation but there could be others. While Pittinger opines that there was a "known risk of fault-related compartmentalization potentially limiting the eastern extent of the oil accumulation," this was not confirmed until drilling Shen-5 and Shen-6.

617. **Pittinger ¶ 110:** "Oudin wrote an email to Wilkins regarding an east-west trending fault he had interpreted just north of Shen-3. Exhibit 22 shows a seismic line running NNW to SSE through the Shen-3 location. Given the potential for this fault to seal, Shen-3 was not located effectively to be an injection well and provide pressure maintenance to up-dip production wells to the north."

618. **Rebuttal to Pittinger ¶ 110:** Pittinger argues that Shen-3 would not be a suitable location for an injection well because of an east-west fault up-dip that Mr. Oudin had interpreted. Pittinger neglects to mention that not a single partner map from this time frame has any such fault interpreted on it. By 2017, and with a new seismic dataset, Development had removed this fault from their maps.[556] Regardless, even if there was a fault there, it would not necessarily preclude the well from serving as a possible water injector. Water injectors for pressure support provide that support over the entire pressure cell that they are in contact with. A fault would only preclude the well from being a water injector if the fault actually existed, if the fault sealed every reservoir's

[555] APC-00020506.

[556] *See* APC-01286239 at slide 49.

up-dip oil column from its down-dip aquifer, and if pressure support of those up-dip reservoirs was needed.

619. **Pittinger ¶ 111:** "Shen-3 was also not suitable as an injection well at the time because it was not designed for that purpose. Oudin relayed this to Kendall in Exploration, as shown below.

> 'Subject: Shen 3 non-utility as Wilcox WI
>
> Beth, I checked with Lea and she said that Shen 3 cannot be utilized as a water injector given its current design. Chip'"

620. **Rebuttal to Pittinger ¶ 111:** As discussed above in response to Merrill ¶ 83 and Pittinger ¶ 85, the issue with Shen-3 not being appropriate as a water injector had to do with the design and condition the well was left in. Mr. Chandler testified: "I think what Lea [Frye] was getting at was the design of the well, the way it was drilled, the way it would have been left would not be something that could be turned into an injector well."[557] Ms. Frye testified that at the time, the required "technology did not exist . . . to complete the Shenandoah 3 well based on the tree which is at the top of the wellbore."[558] However, Mr. Daniels testified that he believed that, if and when the engineering became available, Shen-3 could potentially be used as a water injection well for a well to the east, even if there was a north-south sealing fault.[559] Mr. Leyendecker confirmed that view in his testimony that, even if there was a sealing fault, Shen-3 could be used for pressure maintenance on the east side of the field.[560] He testified that he had discussions about Shen-3 being

[557] Chandler Dep. Tr. 149:17-21.

[558] Frye Dep. Tr. 79:11-14.

[559] Daniels Dep. Tr. 86:21-87:9.

[560] Leyendecker Dep. Tr. 183:23-184:10.

used as a water injector well,[561] and that he did not recall ever learning that Shen-3 could not be used as such.[562]

621. **Pittinger ¶ 112:** "Shotts prepared a presentation for late February 2015 . . . in which he states on a summary slide: '*Pressure data suggests multiple, vertically-stacked, horizons in separate compartments*' and '***Up-dip and down-dip wells separated by >1 mile; not in pressure communication***.'" (emphasis supplied by Pittinger)

622. **Rebuttal to Pittinger ¶ 112:** The presentation Pittinger refers to was work that Mr. Shotts had completed before the data from the drilling of Shen-3 was available.[563] This is clear for several reasons. First, the OWCs used in Mr. Shotts's analysis are "Lowest known oil" from Shen-2 well, and "half-way between Spill Point & LKO."[564] This is the estimate of OWC that was used *before* Shen-3 was drilled. Second, the references to "up-dip" and "down-dip" wells being "not in pressure communication" with each other[565] is a reference to the Shen-1 and Shen-2 wells, not the Shen-2 and Shen-3 wells, since the projected OWC derived from using pressures in the Shen-3 well and the Shen-2 well assumed they were in pressure communication. Third, the February 2015, version of Shotts's presentation[566] which he circulated to the Exploration team, updated slide #3 to clearly state that: "*Significant Subsurface Uncertainty Remains;* inferences must be made for scoping assessment."[567]

[561] *Id.* at 197:8-198:24, 199:13-200:15.

[562] *Id.* at 194:13-17.

[563] *See* APC-00000959.

[564] APC-00865047 at slide 5.

[565] *Id.* at slide 3.

[566] *See id.* at slide 1.

[567] *Id.* at slide 3.

623. Mr. Shotts had generated the "scoping study" to investigate the impact of potential discontinuities in the subsurface and to understand "sensitivities" to the unknowns that remained at Shenandoah after the Shen-2 well. His conclusions were that for fixed reservoir volumes, compartmentalization and pressure support (via aquifer or injection wells) would be the most significant impacts to the field's recovery factor. The "Up-dip and down-dip wells separated by >1 mile; not in pressure communication" statement that Pittinger refers to was an "Introduction" assumption by Mr. Shotts and a starting point for his modeling of reservoirs across the Shenandoah field with sealing east-west faults located every 1-mile (eliminating any possible pressure support). Mr. Shotts described these faults in his testimony as "not based on physical mapping" and "arbitrary in the sense that [they were] just a grid."[568] Additionally Mr. Leyendecker testified that Shotts's presentation conflicted with the interpreted maps of both Beth Kendall and Chip Oudin[569] and that Shotts's faults were artificial.[570] Because Mr. Shotts's work had not been based upon any real reservoir interpretations at Shenandoah, and because it did not incorporate the recent Shen-3 results, a presentation of his work in February 2015 was cancelled.

624. **Pittinger ¶¶ 113-115:** "Shotts' presentation was abruptly cancelled, not long after Leyendecker complained to the manager for Shotts' group, Bob Talley: 'Robert, perhaps you can help the presenters with one of our core values – open communication.' In my expert opinion, a presentation of this sort is important technical work that invited useful discussion on a key risk factor, and there was no basis for keeping it confidential from others within the same company. The exchange showed Leyendecker's efforts to censor technical opinions and prevent open

[568] Shotts Dep. Tr. 147:2-5.

[569] Leyendecker Dep. Tr. 188:13-189:12.

[570] *Id.* at 190:19-25.

communication that ran counter to his preferred narrative. . . . Shotts was not the only person frustrated by censorship. Oudin wrote a sarcastic email to Shotts and Frye about the effort to cancel Shott's presentation."

625. **Rebuttal to Pittinger ¶¶ 113-115:** As an initial matter, Pittinger ignores that Shotts had already given similar presentations to the partnership.[571] Presentations, even when given within a company should be based upon actual data when it is available. Modeling studies are useful to understand sensitivities, but they never are used to represent a project where real structure maps are available, and a couple of specific real scenarios can be tested.

626. **Pittinger ¶ 116:** "There was growing concern that Exploration's over-optimistic assumptions and the lack of transparency were creating a misimpression that Minimum Economic Field Size (MEFS) would be reached by Shen-4. McGrievy emailed Hollek about his concern about being straight with partners regarding the range of interpretations. The different interpretations relate to the role of faulting, the likelihood of pressure continuity between Shen-2 and Shen-3, and what did the pressure data in the Shen-3 water leg prove or not prove."

> "I'd like to meet with you in advance of our meeting with Ernie and Company next Wednesday. I'm still concerned about our ability to be straight with our partnership on various alternative interpretations. We need to be transparent in order to reach consensus on a MEFS strategy and would like your thoughts on how we proceed. My guess, judging by the slide that Alan forwarded to you and I that they believe they will have reached MEFS with the next well."

627. **Rebuttal to Pittinger ¶ 116:** Again, Exploration was pursuing a different strategy from that of the Development team (who is under pressure to quickly reach an economic development plan) and that of ConocoPhillips (who had expressed clearly its preference to drill not in the west to prove up potential area, but instead drill closer to Shen-2 and more centrally in

[571] *See* APC-00137267; APC-00001974.

the basin to prove MEFS). Mr. McGrievy is arguing for broader sharing of Anadarko Development's "alternative interpretations" with partners. Pittinger's claim that "Exploration's over-optimistic assumptions and the lack of transparency were creating a misimpression that Minimum Economic Field Size (MEFS) would be reached by Shen-4" is unsupported. Exploration had a different approach to mapping faulting than Development, and Pittinger does not provide support for the suggestion that Exploration ever represented this choice of Shen-4 locations as being made for reaching MEFS. Pittinger also does not explain what the "different interpretations" regarding "the role of faulting, the likelihood of pressure continuity between Shen-2 and Shen-3, and what did the pressure data in the Shen-3 water leg prove or not prove" has to do with the selection of Shen-4's location.

a. *Rebuttal to Pittinger Opinions re: Lead up to Shen-4:*

628. **Pittinger ¶ 117:** "Following Shen-3, partners shared their structural models along with their mapped faults. Compared to Exploration's map with a single fault, COP, Venari, and Anadarko's Development Team mapped substantially more faults."

629. **Rebuttal to Pittinger ¶ 117:** Pittinger neglects to point out that partners Cobalt and Marathon did not have any faults on their maps, or that each of these partners/teams (ConocoPhillips, Venari, and Anadarko's Development) had their faults in different locations and with different orientations. Clearly, with such a range of uncertainty on where to position faults on an official map, Exploration continued to only show the one north-south fault that it felt most confident about and for which there was a consensus among the majority of the partner teams.[572]

630. **Pittinger ¶ 118:** "In a partner meeting on March 3, 2015, one of the presentation slides compared each partner's structure maps, shown in Exhibit 23. The Anadarko map included

[572] *See, e.g.*, Marathon_004981 at slide 41.

one north-south fault, and no map representing the Development team's interpretation was shown. Both COP and Venari showed considerably more faulting. The assertion that Shen-3 pressures are likely to be in communication with Shen-2 across these mapped faults does not appear to be supported by several of these interpretations." The Exhibit that Pittinger references is shown below.

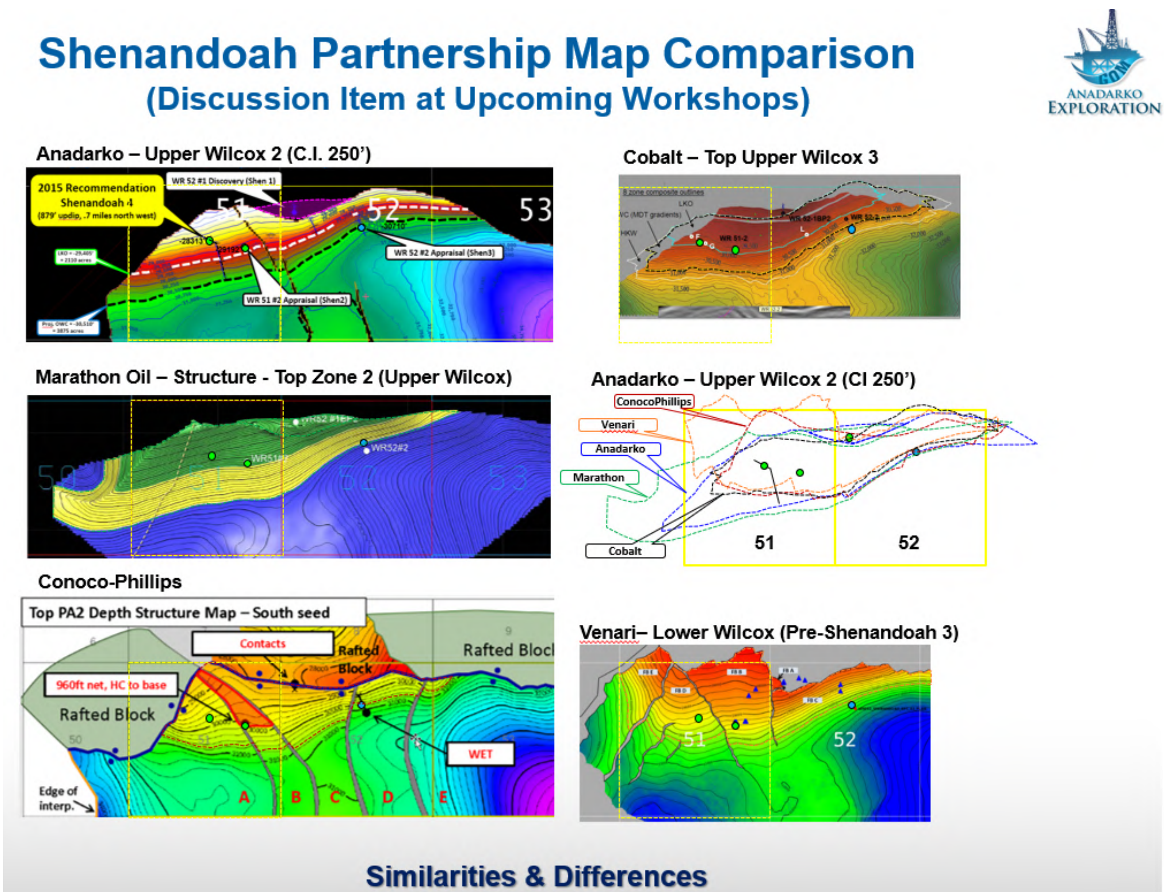


Figure 69 – Comparison of Partner's Structural Maps.[573]

631. **Rebuttal to Pittinger ¶ 118:** Pittinger draws an incorrect conclusion from the comparison of partner maps in March 2015. A closer inspection of these maps indicates that all

[573] APC-00165815 at slide 6 (Pittinger Expert Report Ex. 23 p. 50).

of the partners are interpreting either no faulting or some type of pressure communication across these faults.

- Anadarko Exploration's map indicates LKO and Projected OWC from Shen-3 at a common depth contour on both sides of its north-south fault.
- Marathon's map shows no north-south faulting.
- ConocoPhillips' map shows five fault blocks (separated by four north-south faults) with an estimated OWC in "dashed red line" that is drawn at a common contour across every fault block, implying that they are interpreting all faults as "non-sealing." It is not clear whether this line is its HKW or a Projected OWC from Shen-3, but it is clearly different than its LKO which is only drawn in the Shen-2 fault block.
- Cobalt's map shows no north-south faulting.
- Venari's map shows four major fault blocks (separated by three ~north-south faults) with a Projected OWC from Shen-3 that is drawn at a common contour across every fault block, implying that it is interpreting all faults as "non-sealing."

632. **Pittinger ¶¶ 119-120:** "In planning for a workshop with partners, Oudin wrote to Frye about how to represent his interpretation of structure mapping versus Exploration's and mentioned, '*we are still a house divided.*'"

633. **Rebuttal to Pittinger ¶¶ 119-120:** Mr. Oudin testified that this presentation did not have to do with sharing maps with the partners and that it was a workshop related to exploration planning.[574] Clearly, Mr. Oudin did have a "difference of opinion" on his interpretation from that of exploration that was well documented.[575]

634. **Pittinger ¶ 121**: "On April 15, 2015, Oudin announced that his recent work on mapping the Cretaceous surface showed more faults than previously shown:

> 'Attached powerpoint illustrates some of the changes that I'm attempting to make to the current interpretation, for better or worse. I've shown examples for the

[574] Oudin Dep. Tr. 171:3-17.

[575] Expert Report of Lyndon Pittinger, ¶ 120.

> Cretaceous surface, which is effectively our 'basement' horizon for the Shenandoah model. You can see significantly more faults applied to the current interpretation, which are **complicating (and delaying) output of a final set of horizons that tie together nicely and which terminate cohesively around the perimeter of the model area**.'" (emphasis added)

635. **Rebuttal to Pittinger ¶ 121**: While Pittinger focuses on the "number" of potential faults that Mr. Oudin interprets, he ignores the "inconsistency and uncertainty" that Mr. Oudin admits to that made it difficult to create a consistent interpretation. Mr. Oudin's own emails indicate that he continued to learn about the subsurface with new data, indicating Development's maps were not as "accurate" as Pittinger suggests.

636. **Pittinger ¶ 122:** "A geologic modeling workshop was held on April 30, 2015 providing a comparison of some partners' fault models. At this time, Anadarko Exploration's mapping included two faults, and the Development group's map is shown in Exhibit 24 with faults shown as red linear features. This map includes a complex set of faults ranging from north-south to east-west. COPC's geologic model included two faults in one scenario and no faults in the other, accompanied by the following note: '*Likely to be additional faults* . . . .' Marathon's model included three faults."

637. **Rebuttal to Pittinger ¶ 122:** Pittinger's discussion here is misleading, as he ignores the different purposes that structure mapping and geomodeling serve in an appraisal project. Specifically, Pittinger references slides from a geomodeling workshop presentation, and without explanation, shifts to discussing a faulted structure map created by the Development team. As noted at the top of Pittinger's Exhibit 24, this map was an "alternate scenario" that was a "work in progress,"[576] at this point in the project, thus it could not have been the basis for a completed geomodel. As discussed in more detail above, geomodels serve the purpose of providing a base

[576] APC-00029360 at slide 10.

case upon which simulations of certain scenarios or sensitivities can be created. The highly-faulted map referenced here included low confidence interpretations that would have been inappropriate to include in the base case geomodel given the level of uncertainty at that time. Additionally, from a technical perspective, it is good practice to include only high-confidence faults in a geomodel, as additional faulting can be added in the simulation stage as more is learned about the structure of the field.[577] In fact, the ConocoPhillips model Pittinger cites describes this exact process, noting that in its faulted option, "two additional faults," which Pittinger fails to mention, "will be added to [the] simulation model."[578] Overall, this document only makes clear that the partnership was essentially in agreement over the basic structure that should serve as the foundation for geomodeling and reservoir simulation geomodel, which was one of the main objectives of the geomodeling workshops hosted by Anadarko.[579]

638. **Pittinger ¶ 123:** "On May 7, 2015, COP provided slides of their geologic modeling. Their key elements summary stated that '*a faulted case [was] most likely*,' shown in Exhibit 25. As a result of the complexity that faults presented, a range of uncertainty would exist for OWCs in untested blocks. This stance would make it highly unlikely that pressure continuity existed between Shen-2 and Shen-3, leaving the OWCs down-dip of Shen-2 unknown."

639. **Rebuttal to Pittinger ¶ 123:** Pittinger draws an incorrect conclusion from ConocoPhillips' May 2015 presentation. The range of uncertainties that ConocoPhillips was exploring in this presentation related to which fault blocks would be charged with hydrocarbons.

[577] Shotts Dep. Tr. at 36:6-14 ("I would prefer to have them build the model with only faults that they know [] exist[], because if they put a bunch of other faults in, I can't take them out, as opposed to just installing them in on my end.").

[578] APC-00029360 at slide 22.

[579] *Id.* at slide 4 (noting a workshop goal as "defin[ing] the basis of a suite of partner-aligned models that capture the range of potential reservoir outcomes.").

Its faults are not modeled sealing the down-dip aquifer from the up-dip oil in any fault block, as the key issue for ConocoPhillips was the producibility of the eastern area. In addition, Pittinger's statement that "a range of uncertainty would exist for OWCs in untested blocks" is obvious since there is no certain knowledge that hydrocarbons exist in an "untested block" or that oil pressure could be measured to project an OWC if the block is untested. His statement that "[t]his stance would make it highly unlikely that pressure continuity existed between Shen-2 and Shen-3, leaving the OWCs down-dip of Shen-2 unknown" does not logically follow from his previous statement, and is not a conclusion that ConocoPhillips arrives at in the referenced presentation.

640. **Pittinger ¶ 124:** "In an email dated August 15, 2015, Oudin wrote to Chandler that if Shen-4 results were as complex as Shen-1, the 'entire house of cards comes crashing down.' In the same email chain, Ramsey informed the Exploration team that Shen-4 encountered Eocene salt similar to Shen-1 instead of the Wilcox sands. Oudin emailed Chandler on August 15, 2015:

> 'Exploration may have backed themselves into a corner. We/they should expect nothing but Shen-2 type pays, because this entire project has been built on the premise that Shenandoah's type log for the entire structure is Shen-2. If Shen-4 looks like Shen-1 (or worse), then the entire house of cards comes crashing down. Sadly, if Shen-4 doesn't work, then Exploration will have destroyed whatever value Shenandoah had for APC.'"

641. **Rebuttal to Pittinger ¶ 124:** Pittinger incorrectly characterizes Mr. Oudin's email regarding the Shen-4 results. It is true that "if Shen-4 results were as complex as Shen-1" with upper Wilcox section missing and lower Wilcox sands that were either wet or with OWCs, this would have resulted in a downgrade of recoverable volumes. But, as discussed below in Section VI.E.1, this is not what Shen-4 encountered. Moreover, Pittinger overextends the value of Mr. Oudin's analysis, as Shen-4 nonetheless helped to better define the correct interpretation and the appropriate plan forward.

642. **Pittinger ¶¶ 125-126:** "Oudin emailed John Blackburn with COP regarding a cross-section that Trautman had sent to partners. The probable tone of sarcasm in the following quote addresses his disagreement that the Exploration team presented a cross-sectional model with no faulting between Shen-2 and Shen-4, despite numerous faults evident in the dipmeter.

> 'Got this from COP, or should I say from Exploration via COP. Interesting to note that the Wilcox sands are unfaulted between Shen-2 and Shen-4, despite some evidence of faulting in the Shen-4 dipmeter. What did Paul say on Saturday? Oh, yeah . . . "Hope springs eternal."'"

643. **Rebuttal to Pittinger ¶¶ 125-126:** However, the email that Mr. Trautman sent included the following text: "Please find a 'schematic cross-section' that portrays the *dips, salt body presence, and stratigraphic age* encountered thus far in the Shenandoah 4 well. Keep in mind that *this is a work in progress* and we understand that other interpretations are possible. Modifications are very likely as additional information is obtained as we drill ahead. *Please feel free to share any alternative interpretations* being worked by your teams."[580] Clearly, the cross-section was intended to show "dips, salt body presence, and stratigraphic age," and was drawn in such a way as to showcase those attributes. **Figure 70**, below, is the cross section included in Mr. Trautman's email:

[580] APC-00642417 (emphases added).

CONFIDENTIAL

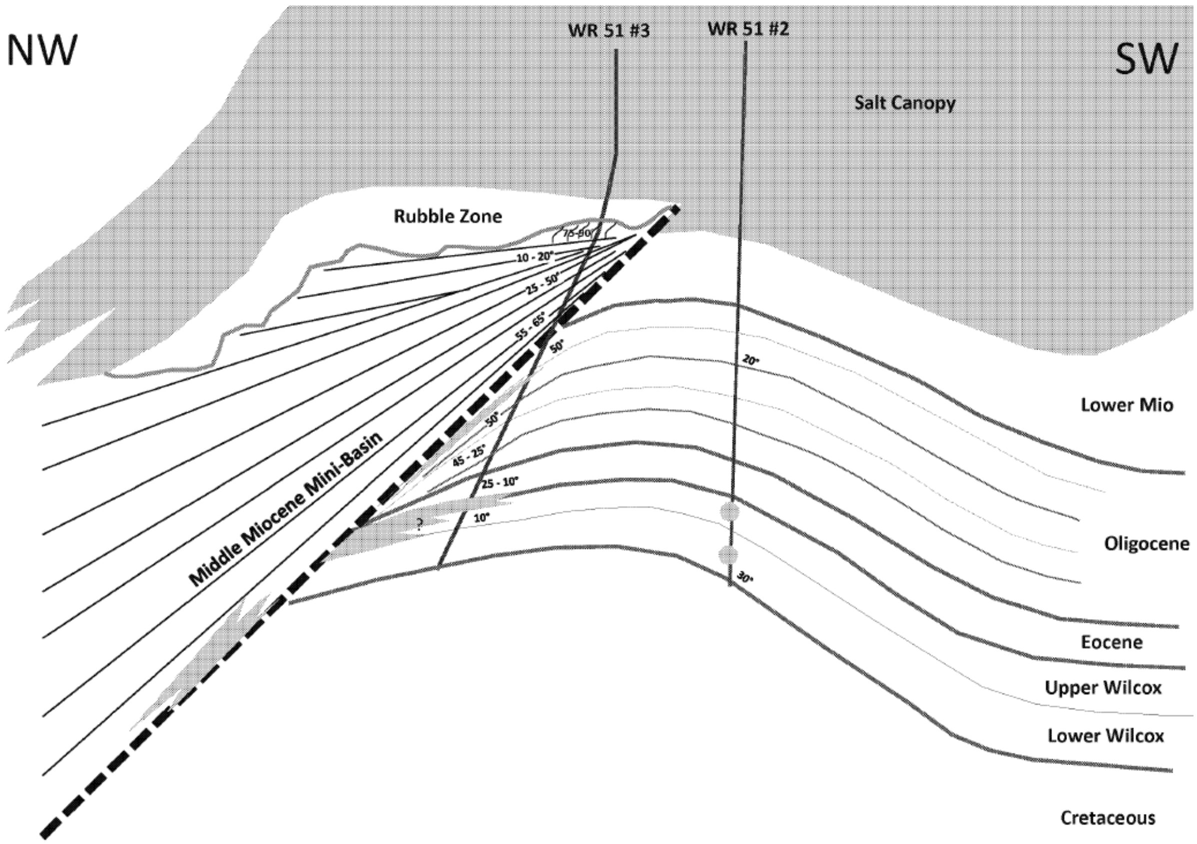


Figure 70 – Preliminary Cross-section of Shen-2 to Shen-2 sent by Mr. Trautman.[581]

644. Inspection of this Figure shows a cross-section that starts in the northwest on the left and is drawn up-dip and then down-dip to the Shen-2 well and ends in the southwest in the center of the basin. Obviously, this cross-section is not drawn along a straight line. Without an index map to show where this cross-section is drawn, whether or not it crosses any faults and where those would cut this cross-section cannot be determined. Mr. Oudin and Pittinger do not address this fact.

645. **Pittinger ¶ 127:** "In an email dated August 26, 2015, the Development team appeared to be leading discussions with partners regarding the appraisal strategy determining the target area of the upcoming well Shen-5. Oudin wrote to Blackburn and Chernoff at COP to

[581] APC-00045971.

explain his reasoning for preferring Location WR52-L. Once again, a tone of sarcasm was expressed in his hopes that certain people, likely Leyendecker's Exploration team, might be developing an appreciation for the complexity faulting was having on their appraisal results."

646. **Rebuttal to Pittinger ¶ 127:** Pittinger correctly notes that in "August 26, 2015, the Development team appeared to be leading discussions with partners regarding the appraisal strategy determining the target area of the upcoming well Shen-5" and notes that Development's preference for location was the "Shen-L" location. Pre-Shen-5 Anadarko Development team took the lead for determining the next appraisal location. Instead of drilling its preferred location for Shen-5 at the "Shen-L" location to test the up-dip eastern fault block, it deferred to ConocoPhillips' preference to stay closer to Shen-2 and drill Shen-5 at the "Shen-E" location.[582]

b. *Rebuttal to Pittinger's Opinions re: Post Shen-3: Exploration Team:*

647. **Pittinger ¶¶ 197–205:** "Resource ranges and estimates dropped after Shen-3 for both Exploration and Development. Exploration noted a 47% decrease in mean area and 23% decrease in recoverable resources, yet also assumed a 32% increase in net pay. . . . The structure maps that provide the basis for these P90 and P10 area estimates are in APC-01678818 . . . . In my expert experience, this contour would represent the maximum areal extent for a much rarer P1 upside case rather than the P10 case. . . . The P90 (white dash) limit follows the contour at a depth of the lowest known oil in Shen-2 on the southern side of the structure but follows the same northern edge as the upside case. This downside case would be valid if the field's northern, eastern, and western limits were known with certainty and that no faults could isolate an oil field block from a water-bearing block. At this stage, COP had already mapped and shared with partners

[582] APC-00214510.

multiple north-south trending faults capable of causing isolation between blocks. In my expert opinion, the assumed P90 area significantly underestimated the potential downside risk in the extent of the oil accumulation. Note that the proposed location for Shen-4 was well within the P90 area indicating virtually no risk of a dry hole. The original Shen-4 wellbore at this location encountered salt instead of oil filled Wilcox sands, proving Exploration's estimate of the P90 downside area too optimistic. . . . In my expert opinion, this attempt at describing the range of possible outcomes is not credible and lacks professional judgment, showing minimal downside risk."

648. **Rebuttal to Pittinger ¶¶ 197–205:** Pittinger makes note of the change in resource estimates as a result of the Shen-3 appraisal well. Pittinger seems to imply that there is an inconsistency here, but the fact is that Shen-3 changed the dip on the reservoirs which resulted in a change in the contouring of the maps affecting the area and net pay values. It also changed the isopachs of the net sand and net pay maps with additional proved thickening of sands down-dip. Finally, it moved the OWCs of the P50 and P10 cases reducing the areas enclosed by the up-dip contours. Pittinger critiques the Exploration team as to its interpretive choices, decisions, and interpretive capabilities. As with most interpretations, its validity lies in honoring the data available, and in having an informed opinion about the remaining risks and uncertainties. Honoring the data is immutable but opinions as to likelihoods are unique to every individual and team. That Exploration had a different technical interpretation that was ultimately incorrect does not equate to a "lack of professional judgment."

649. **Pittinger ¶¶ 206-211:** "Net pay assumptions increased by 32% from the June 2013 evaluation to the November 2014 update following Shen-3. The estimate for net pay, which, by definition, is oil-filled reservoir quality sands, needed to consider results encountered in the three

wells drilled up to that time, plus seismic analysis indicating thinning of the Wilcox section toward the crest of the structure. Exhibit 50 summarizes net pay results by horizon, porosity, and permeability results, along with Exploration's average net pay for the field, shaded in yellow."

	Shen-3			Shen-2			Shen-1			11/14 MMRA		
Zone	Net Sand, ft	Porosity %	Permeability, mD	Net Pay, ft	Porosity %	Permeability, mD	Net Pay, ft	Porosity %	Permeability, mD	P90 Net Pay, ft	Mean Net Pay, ft	P10 Net Pay, ft
UW1	214	17.7%	4	142	20.3%	37	NA	NA	NA	165	217	274
UW2	350	18.6%	9	240	21.8%	81	NA	NA	NA			
UW3	NA	NA	NA	23	21.1%	28	NA	NA	NA	240	269	300
LWA	267	18.5%	11	160	22.5%	77	30	22.9%	511	175	187	200
LWB	149	18.5%	17	139	22.0%	49	0	21.5%	258	125	132	140
LWC	60	17.8%	9	166	20.0%	21	39	21.4%	293	125	137	150
LWD	203	18.7%	17	38	16.0%	4	91	22.6%	127	80	90	100
LWE	227	17.2%	8	94	19.3%	18	76	25.0%	727	100	135	175
Total	1470			1002			236			1010	1168	1339
Average		18.1%	11		20.4%	39		22.7%	383			

Exhibit 50:Net Pay, Porosity, and Permeability of Shen-1, -2, and -3

Figure 71 – Pittinger's Exhibit 50 showing net pay results.[583]

650. "Shen-1 is highest on the structure of these three wells and encountered only 236 ft. of net pay with the Upper Wilcox missing and wet sands through most of the LWA, LWB, and LWC horizons. Net reservoir sand totaled 463 ft., with approximately one-half of the sands water-bearing. Net pay in Shen-2, located down-dip of the crest and near the assumed OWC, totaled 1,002 ft. TVT with all sands filled with oil, making it the best pay result in the three appraisal wells. Shen-3, located 1,518 ft. down-dip of Shen-2, was wet with no net pay but had 1,470 ft. TVT of reservoir sands, which would be expected considering the evidence for crestal thinning and down-dip thickening observed as early as 2009. . . . [N]et pay estimates in paragraph 206 are based on thickening toward the crest rather than thinning."

651. "Because the P90 areas were based on the lowest known oil (LKO) in Shen-2 for all horizons, nearly all the P90 areas must be up-dip of Shen-2. With crestal thinning, net pay would decrease up-dip, resulting in a lower average net pay than Shen-2. A thicker average net

583 Expert Report of Lyndon Pittinger, ¶ 206.

pay up-dip of Shen-2 is very unlikely with crestal thinning. Instead of accounting for crestal thinning in their estimate, this study was based erroneously on finding thicker sands up-dip of Shen-2."

652. **Rebuttal to Pittinger ¶¶ 206-211:** Pittinger is particularly mistaken in his critique of Exploration's post-Shen-3 estimates of net pay. The Exploration team properly accounted for the three Shenandoah wells and made updated isopach maps (see Figures below). These maps were then used to generate net pay values using the same methodology as before the drilling of Shen-3, but with thicker net pay to the east (due to increased dips and penetrated sand thickening) and movement of the P10 OWC up-dip.

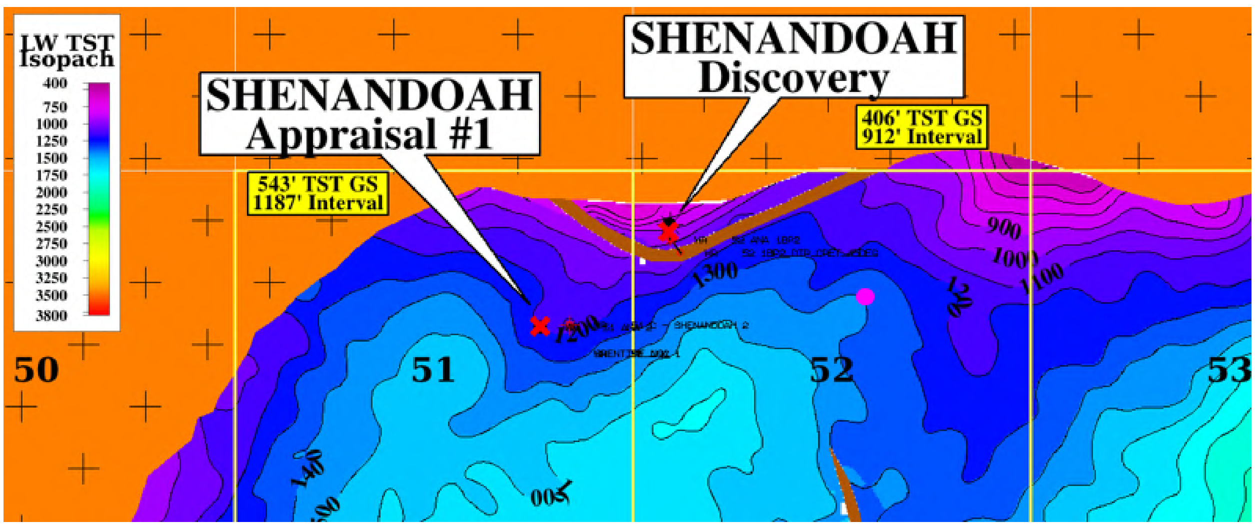


Figure 72 – Anadarko Exploration isopach Lower Wilcox after drilling of Shen-3 well showing continued thinning of reservoir sands up-dip. Changes in the thickness contouring represent updates in net sand laterally based upon well data.[584]

[584] APC-00016754 at slide 83.

CONFIDENTIAL

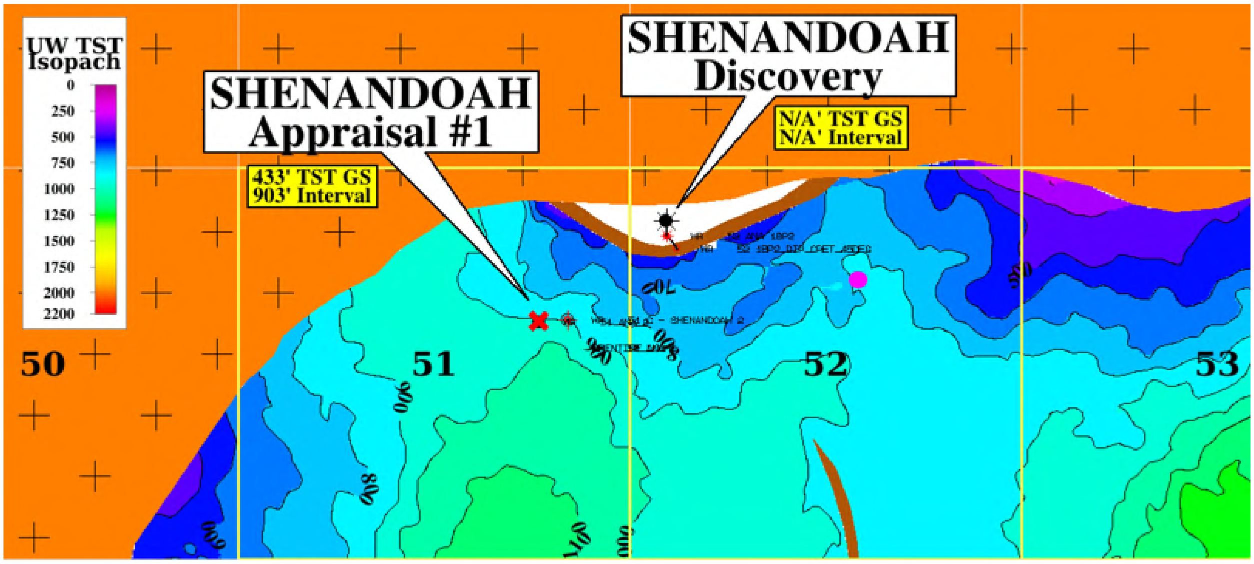


Figure 73 - Anadarko Exploration isopach Upper Wilcox after drilling of Shen-3 well showing continued thinning of reservoir sands up-dip. Changes in the thickness contouring represent updates in net sand laterally based upon well data.[585]

653. The Anadarko team therefore used isopach maps both before and after the drilling of Shen-3 to help make their net sand estimates, and these isopaches of both Upper and Lower Wilcox sands both before and after the drilling of Shen-3 clearly show thinning of the sands up-dip as a standard feature. The "[n]et pay assumptions increased by 32% from the June 2013 evaluation to the November 2014 update following Shen-3" because of the increase in net sand mapped laterally and down-dip.

654. Pittinger's conclusion that net pay assessment increased between the Shen-2 and Shen-3 wells based on the assumption of crest thickening is incorrect. The Anadarko team used isopach maps both before and after the drilling of Shen-3 to help make their net sand estimates, and these isopaches of both Upper and Lower Wilcox sands both before and after the drilling of Shen-3 clearly show thinning of the sands up-dip as a standard feature. Pittinger cites no maps or presents any evidence for this conclusion. I am not aware of any maps showing thicker sands up-

[585] APC-00016754 at slide 80.

dip. The increase in net pay estimates are because of the increase in estimates of net sand laterally and down-dip indicated by the Shen-3 well.

655. **Pittinger ¶ 214:** "An email shown in Exhibit 52 from Trautman (Exploration Manager) establishes that the mean resource estimate of 920 MMBOE before Shen-4 was the version preferred in this period by Exploration over the 'Fault Model' with the mean of 740 MMBOE. The email also highlights an updated case Post Shen-4 with a mean size of 755 MMBOE, discussed in the next section."

656. **Rebuttal to Pittinger ¶ 214:** While Pittinger claims that Exploration "preferred" the no-fault model, the email referenced does not indicate "preferred version" but just references a "pre" number to compare to the "post" number. There is no specification as to whether this was "preferred number," the "most recent number," the "Exploration number," or anything else. The email reads:

> "Updated Resource Range for Shenandoah:
>
> P90 = 635 MMBOE
>
> P50 = 749 MMBOE
>
> **Mean = 755 MMBOE**
>
> P10 = 883 MMBOE
>
> Prior Mean (before Shenandaoh 4) was **920 MMBOE**
>
> The team is still working on the range of resource potential for the southwest fault block."[586]

657. There are no indications in this email of any of the "preferences" that Pittinger claims. Mr. Trautman simply highlights the current Mean and the Prior Mean.

c. *Rebuttal to Pittinger's Opinions "Post Shen-3: Development*

[586] Expert Report of Lyndon Pittinger, ¶ 214; APC-00209545.

Team"

658. **Pittinger ¶ 216:** "There is evidence that senior management was concerned about the large difference in resource size. This statement from Hollek to McGrievy indicates that Chuck Meloy, a member of the Executive Committee at the time, was concerned that Anadarko's portfolio contained Exploration's over optimistic numbers:

> Hollek to McGrievy: 'One of the issues I know Chuck still has is that Portfolio still contains Exploration scenario which he knows is different than our runs. Like I told him our numbers are built on the latest assumptions of costs and activities on what we know today.'"

659. **Rebuttal to Pittinger ¶ 216:** Pittinger references this as "evidence that senior management was concerned about the large difference in resource size." This email indicates only that Chuck had an "issue[]" with the portfolio containing Exploration's numbers; however, as Hollek wrote in his email, that was based on the "latest assumptions of costs and activities on what we know today."

660. **Pittinger ¶¶ 217–220:** "An important finding from Shen-3 was that the Development team observed that aquifer pressure trends in Shen-1 and Shen-3 both followed the same 0.50 psi/ft. regional pressure gradient as shown in Exhibit 53. This similarity establishes possible but not proven pressure continuity between the two wells and such a connection, if true, had strong negative implications to the areal extent of oil. Shen-1 encountered water-bearing sands near the crest of the fault block, and the much shallower OWCs established by water-bearing sands in the LWB and LWC sands would therefore extend across much of the eastern fault block if Shen-1 were connected to Shen-3. . . . The oil in place volume for the eastern block was calculated by Shotts to be only 85 MMSTB assuming the Shen-1/Shen-3 connected model . . . . The Exploration Team dismissed the possibility of the two wells being connected despite recognizing that they were the same regional pressure gradient of 0.50 psi/ft. In my expert opinion, Exploration's basis for

dismissing pressure connection between the two wells due to high fluid densities near Shen-1 lacks credibility."

661. **Rebuttal to Pittinger ¶¶ 217–220:** Pittinger makes note of a key difference in the way Exploration interprets the similar water pressure gradients seen in Shen-3 and with Shen-1. Pittinger is correct in his assessment that this was an important unknown, and this unknown was a key interpretation difference between the Exploration and Development teams. Such a common water pressure would not be unusual as the hydrostatic gradients in this subsalt basin have likely been established as a regional gradient, and common water pressure do not necessarily imply any aquifer connectivity, especially given the known and mapped fault/weld which Pittinger and Exploration had argued is sealing. However, if Shen-1 was open to Shen-3, then the consequences for the eastern trapped area would be significant. Pittinger references the consequences of a "connected" interpretation, which would result in a lowering of the oil in place volume. Development interpreted this risk as central to its development planning and argued to appraise it. This was in contrast to the Exploration interpretation that did not consider this a significant risk and wanted to appraise the western portion of the field first. Regardless, Exploration's interpretation was viable because it interpreted a mapped fault/weld separating Shen-1 from Shen-3, and the common aquifer pressure was not strong evidence of connectivity.

662. **Pittinger ¶¶ 222-226:** "The Development team used a simplified approach of combining all sands into a single total net pay distribution for all horizons combined, requiring only one MMRA file to complete the estimate."

663. **Rebuttal to Pittinger ¶¶ 222-226:** Pittinger spends a number of paragraphs describing the Development team's methodology for estimating recoverable resources. He takes issue with Exploration's technical work, but does not suggest it represents anything other than its

best technical interpretive opinions. The fact that they will differ from Development's again represents their differences in perception of risks and uncertainties. The best value would have been in the two team's arriving at a common interpretation that jointly represents their risked views—which they did at the RCT following Shen-4.

664. **Pittinger ¶ 227:** "Based on searches of the documents available, the MMRA evaluation of April 19, 2015 appears to represent the first full-field update by the Development team following the results from Shen-3. By removing almost half of the upside area (based on Shen-3 being wet) on the southern side of the structure and accounting for thinning onto the structure, the Development team's mean resource estimate of 397 MMBOE decreased by 57% from the previous year's estimate of 767.5 MMBO, equivalent to 931 MMBOE with the associated gas equivalent included. In my expert opinion, the Development team's assessment is substantially more credible than Exploration's model, which ignored crestal thinning and assumed the opposite."

665. **Rebuttal to Pittinger ¶ 227:** While Pittinger endorses Development's methodology, he bases his conclusion on incorrect assumptions. As already explained, Exploration's model did not "ignore[] crestal thinning and assumed the opposite." While Pittinger critiques Exploration's methodology for resource estimates using MMRA, he does not point to evidence suggesting the Development team had similar issues. Pittinger's opinion is simply that agrees with Development's approach. However, the Development methodology for resource estimation is neither better or worse than the estimates that Exploration made—both are predominantly factually correct, but they differ in the way they interpret uncertainties and in how they manage risks. As discussed above, these differences are typical among exploration and

development teams working on the same project, and stem primarily from fundamental differences in each team's overall mission.

666. **Pittinger ¶¶ 228-229:** "On April 8, 2015, the Development team presented a risked economics evaluation for a full field development to Kleckner with a rate of return of just 11%, substantially lower than the 19% rate of return presented on February 19, 2014, with results shown in Exhibit 57. The decline in profitability resulted from a much-reduced resource volume and a lower oil price environment. Following significant oil price declines in early 2015, the base case oil price used in Anadarko's economics was reduced from $95/bbl to $60/bbl. . . . The PIR10 in this risked economics evaluation is noteworthy for two reasons. The first is it falls well below Anadarko's .3 threshold for commerciality, at .08 for risked economics. Second, even though this analysis showed Shen was uneconomic, it was incorporated overly optimistic assumptions. Specifically, this analysis was based on the optimistic assumptions that no east-west faulting existed to limit aquifer support and no damage to flowrates occurred from asphaltene deposition."

667. **Rebuttal to Pittinger ¶¶ 228-229:** First of all, this rate of return was calculated on a P50 value for recoverable volumes that still carried an unacceptably wide range of uncertainty requiring additional appraisal. An economic assessment for the P10 case would be considerably more positive. The most important reason to calculate these economics is to define the areas where resources can be directed for economic improvement. Later slides in this same presentation do that (see Figure below).

CONFIDENTIAL

Figure 74 – Keys to improving the Shenandoah economics.[587]

668. Pittinger places the blame for Development's reduced profitability on "a much-reduced resource volume and a lower oil price environment," but neglects to mention the cost side of the calculation or the impact of timing on the cost of capital. As explained, the 0.3 threshold is only a loose threshold for investment and is not the only consideration. Non-technical risks, downside risk, and exposure to the upside are all important in making a decision to continue in appraisal investment. While Pittinger claims that the results of "this analysis showed Shen was uneconomic," the economic viability of the project is not determined until the appraisal effort ends. Interim economics are useful for determining the areas to focus resources.

669. Pittinger also claimed that "this analysis was based on the optimistic assumptions that no east-west faulting existed to limit aquifer support and no damage to flowrates occurred from asphaltene deposition." However, he does not show any of the Development planning and costs to verify that mitigation and flow assurance are not included in its calculation.

670. **Pittinger ¶ 230:** "The net present value discounted at 10% was only $66 MM for a project with a success case investment of $6 billion to $10 billion. In my expert opinion, the results from Shen-3 caused resource estimates to decrease by more than 50%, seriously impacting

[587] APC-00169083 at slide 25.

the project's commercial viability. This finding sharply contrasts with senior management describing Shen-3 as a successful appraisal well."

671. **Rebuttal to Pittinger ¶ 230:** However, in the costing slide pack, the development costs for the proposed Wet Tree Development with 100 MBOPD Spar was only ~$4 billion,[588] much below an "investment of $6 billion to $10 billion" that Pittinger references. In addition, one does not do economics with "sunk" (exploration and appraisal) costs already in the plan; decisions are based only upon future economics. As explained above, Pittinger's definition of appraisal "success" is not consistent with the objectives of the Shen-3 appraisal set forth by the Shenandoah partnership, as Shen-3 met nearly all of the defined objectives for the well and provided important information.[589]

d. *Rebuttal to Pittinger's Opinions "Post Shen-3: COP"*

672. **Pittinger ¶¶ 231, 234:** "COP's decisions around Shen's commerciality and viability after Shen-3 are particularly informative. Partner unity and approval can act as a form of peer review of the operator. Partners typically provide professional staff to perform their own analysis. Over time COP developed a more pessimistic view of Shen, leading to an eventual decision to sell their interests. COP's estimated resource volume at this time of 360 MMBOE was quite similar to Development's estimate of 396 MMBOE and less than half of Exploration's estimate. Senior management was made aware of this number when COP tried to trade its share in Shen for a different Anadarko asset."

673. **Rebuttal to Pittinger ¶¶ 231, 234:** Pittinger does not represent ConocoPhillips' actions fully. ConocoPhillips expressed an interest in trading its Shenandoah interests for another

[588] APC-00169083 at slide 23.

[589] APC-00000907 at slide 7.

asset named "Alpine." If one examines this document,[590] one can see that ConocoPhillips does not expose its estimation of Shenandoah resources or economics, but that Anadarko Exploration estimates what value its thinks ConocoPhillips would ascribe to the project based upon its knowledge and interaction with ConocoPhillips: "APC's Exploration group has provided evaluations of COP's interest (30%) both from their understanding of COP's mapping and also from their own internal evaluation."[591] Because Anadarko believes that ConocoPhillips is undervaluing Shenandoah, it entertained the possibility of considering such a trade. The trade was not made, and ConocoPhillips participated in the appraisal program through the Shen-6 well and up to the Shen-7 proposal, which it non-consented.

674. **Pittinger ¶ 233:** "On March 10, 2015, COP inquired as quoted below about an asset trade of COP's share of Shen for Anadarko's share of the Alpine asset in Alaska. Such a trade indicates that COP was interested in ridding itself of the Shen appraisal program, especially after COP expressed its concern over the commercial viability mentioned above.

> 'Subject : Alpine - Shenandoah – Conoco
>
> John Schell, BD NA Conoco, called and wanted to know if we would consider an Alpine-Shenandoah trade. I told him I would check to see how much interest we might have. If interested he will vet further in COP. He said they have been kicking it around but I am not sure how high that goes. Thoughts? Budget issues?
>
> Jerry Windlinger, Vice President, Corporate Development.'"

675. **Rebuttal to Pittinger ¶ 233:** Pittinger's conclusion that "[s]uch a trade indicates that COP was interested in ridding itself of the Shen appraisal program" is not true. Such "asset swaps" are common when one company thinks another company is undervaluing or overvaluing an asset. It is a way of increasing value by leveraging what a company believes is its "better

[590] APC-00171344 at -345.

[591] *Id.*

information." In fact, in-between those two events, on October 14, 2014, ConocoPhillips elected to participate in an AFE to cover the planning for Shen-4,[592] and on March 10, 2015—the same day it expressed interest in trading shares in Shenandoah and Alpine—ConocoPhillips elected to participate in a Drill AFE for Shen-4,[593] clearly indicating it intended to continue appraisal.

676. **Pittinger ¶ 235:** "On 10/19/15, COP announced they would discontinue deepwater exploration by 2017: '*On a conference call with analysts, executives said ConocoPhillips planned to exit all deepwater exploration by 2017 as other projects win out in the budgeting process.*'"

677. **Rebuttal to Pittinger ¶ 235:** In support of this decision, ConocoPhillips discussed the existing low commodity price environment and the "aggressive actions" it was taking "across [its] business to position" itself These included exiting all deepwater exploration, not just Shenandoah.[594] However, in announcing it was exiting deepwater drilling, ConocoPhillips also said that it had encouraging results at Shen-4, and that in exiting deepwater exploration, it did not "make a commitment to exit deepwater per se" and that it would only exit its discoveries if it got full value for them.[595] Pittinger provides no explanation for how this supports his view that ConocoPhillips' actions were driven by its "concern over the commercial viability" of Shenandoah as opposed to its desire to adjust its portfolio of assets to reduce its risk profile.

E. Shen-4

1. Well Results

678. As with Shen-3, the next Shenandoah appraisal well— Shen-4, also referred to as "WR 51-3"—was spud shortly after the prior well in order to maintain the unit's leases. Choosing

[592] *See* ANACOP00001136.

[593] *See* ANACOP00001279.

[594] October 29, 2015 COP Earnings Call Tr. at 3.

[595] *Id.* at 5-6.

the location for Shen-4 was discussed extensively among the partnership and between the Anadarko Exploration and Development teams.[596] Anadarko's Exploration team and many of the partners (with the exception of ConocoPhillips) preferred testing the extent of the trap to the west of Shen-2 next, whereas Anadarko's Development team and ConocoPhillips preferred a "less risky" well to the east and downdip of Shen-2 in order to delineate volumes nearer to the Shen-2 fault block and reach Minimum Economic Field Size ("MEFS").[597] In addition, partners were not in complete agreement as to the base of salt interpretation to the west.[598] Agreement was finally reached on the western location preferred by Anadarko's Exploration team, under the condition that Shen-4 would have downdip sidetrack possibilities.[599]

679. Shen-4 was spud at a location up-dip and to the west of Shen-2 on May 25, 2015 with the goals of: 1) proving the presence of oil volume west of Shen-2; 2) narrowing the estimated resource range for the field; 3) acquiring conventional whole core of oil-saturated rock; 4) establishing OWCs; 5) evaluating any lateral reservoir changes or faulting; and 6) gathering additional reservoir and fluid properties.[600] Shen-4 finished drilling its original hole on September 7, 2015 without encountering any of the Upper or Lower Wilcox sands that were present in Shen-2 and Shen-3, instead drilling through non-hydrocarbon bearing Eocene marls and salt.[601]

[596] APC-00001146, APC-00618050, APC-00618490.

[597] APC-00617571; APC-00617572; APC-00852342; APC-00016723.

[598] APC-00172770 at slide 5 (ConocoPhillips' post Shen-3 interpretation including larger updip area).

[599] APC-00618490.

[600] APC-00001146 at slides 107-09.

[601] APC-00049176.

680. Anadarko then commenced sidetrack drilling operations to the southeast of the original hole at Shen-4 ("Shen-4 Sidetrack 1" or "Shen-4 ST1"), which completed drilling on October 18, 2015. Shen-4 ST1 encountered 622 feet of oil that extended 400 feet lower than what was found at Shen-2, lowering the estimated OWC at that location.[602] However, the Upper Wilcox part of the geologic section that had been found in Shen-2 was faulted-out in this well, suggesting additional structural complexity on the west side of the Shenandoah structure.[603]

681. Following success at Shen-4 ST1, Anadarko immediately commenced a bypass coring operation to acquire whole core ("Shen-4 ST1 Bypass" or "Shen-4 ST1 BP"), which was completed around December 9, 2015.[604] The whole core collected in Shen-4 ST1 BP provided important data for reducing uncertainty in the expected recovery efficiency.[605] However, Shen-4 ST1 BP was drilled approximately 400 feet to the east of Shen-4 ST1 and encountered structural differences from the former, which suggested the two wells were drilled through a faulted geologic section.[606]

682. After the Shen-4 ST1 bypass operations, Anadarko proposed a second sidetrack at Shen-4 ("Shen-4 ST2") to be drilled immediately after the Shen-4 ST1 bypass operations were complete. One of the motivations of the sidetrack was to maintain drilling rig operations continuously for the partnership at the Shenandoah field in preparation for the agreed Shen-5 development well that would be spudded in a matter of months.[607] While Cobalt and Venari

[602] APC-00653389 at slide 11.

[603] *Id.* at slide 11; APC-01006587 at slide 3.

[604] APC-01006408 at p. 1; APC-00214592.

[605] APC-00058398 at slide 8.

[606] *Id.* at slides 13, 17.

[607] Marathon_012605.

consented to the Shen-4 ST2 operation, ConocoPhillips, and Marathon did not.[608] ConocoPhillips explained its decision to non-consent as follows:[609]

> "The proposed second sidetrack is unlikely to prove sufficient volumes to support field development in our opinion. This can only be achieved with a successful Shen 5 well, in the undrilled central portion of the field. While we see merit in preserving the ability to sidetrack the WR 51 #2 ST1BP1 at a later date, COP sees no technical justification in drilling this sidetrack until MEFS can be confirmed by the Shen 5 well. To be clear COP's stated position is that all remaining appraisal activities must be driven by the cost effective and efficient appraisal of the field and concept selection [sic]. Our focus remains to support the ongoing appraisal of this discovery in the most efficient and cost effective manner and we remain prepared to follow this discovery to development and in the current low oil price environment we must advocate for the most cost effective, impactful well operations."

683. Shen-4 ST2 began drilling with Anadarko taking up ConocoPhillips' and Marathon's costs and interests.[610] However, Shen-4 ST2 encountered significant drilling problems with hole instability and was abandoned before reaching the Wilcox reservoir interval.[611]

684. In December 2015, a Quarterly Subsurface Meeting presentation noted that the Shen-4 results suggested a "mid-case reduction of ~900 MMBOE [in-place volumes], or ~1/3rd of the mapped STOIPs" and revealed "additional Structural Complexity on West Flank."[612] The presentation also noted the "Potential for structural Complexity on East Flank,"[613] especially in far up-dip areas, near-salt, and emphasized that "Achieving Commercial Threshold likely requires success at Shen 5 & Shen 6."[614] The presentation further recognized the risk of asphaltenes, noting that asphaltenes would impact the completion design and well count, could require intervention

---

[608] Marathon_014843; APC-01730272; APC-00216034.

[609] APC-01730272 at -284.

[610] APC-00216034.

[611] APC-00356191.

[612] APC-00058398 at slide 5; see also APC-01006587.

[613] APC-00058398 at slide 5.

[614] *Id.*

from solvent treatments, and may need pressure support from aquifer and/or injection.[615] This uncertainty would be handled in dynamic modeling and economics.[616] It also included a facilities update that included, among other things, an assessment of the differences between a dry tree spar, wet tree spar, and semisubmersible, and recommendation to move forward with a wet tree concept.[617]

685. In a Shenandoah Project Update from around this time, the Development team listed the "2016 Subsurface Scope of Work" as (1) "Narrow Reservoir STOOIP Uncertainty" through "Appraisal Drilling," "Core and Fluid Acquisition," "Seismic Reprocessing," and "Geo-modeling," and (2) "Reduce Commercial Uncertainty" through "Complete Core and Fluid Analyses," "Dynamic Modeling," "Reservoir Productivity and Flow Assurance Studies," "Water Injection Studies," and "Drilling and Completion Impact Studies."[618]

686. After the Shen-4 wells, the Anadarko Exploration and Development teams were not in complete agreement on Shenandoah's estimated potential resource volumes. Because management of the appraisal project was in the process of being handed over to the Anadarko Development team following the completion of the Shen-4 wells, the Development team sought to convene a review of Shenandoah resource estimates by Anadarko's neutral Risk Consistency Team ("RCT") before submitting an AFE for funding for the next appraisal well.[619] Because the

[615] *Id.* at slides 25-33.

[616] *Id.* at slide 25.

[617] *Id.* at -464 to -529.

[618] APC-01006587 at slide 22.

[619] APC-00660240; Matt Morris Dep. Tr. 89:20-90:2.

Development team would also be submitting economics for the Company-wide portfolio, Development sought to reconcile its economics with the Exploration team's economics.[620]

687. As a result of the RCT meeting, the Exploration and Development team agreed to a joint resource distribution. Lea Frye emailed that distribution to Pat McGrievy, writing that the estimates were "a compromise between the two groups on methodology and on the low side of the distribution," noting that "[o]ver all, we are pleased with the end result."[621]

688. Assessment of recoverable volumes by Exploration, Development, and jointly after meeting with the RCT, are summarized below.

APC Team Opinion	P90 Volumes	Mean Volumes	P10 Volumes
Exploration Pre-RCT Review	635 MMBO	740 MMBO	880 MMBO
Development Pre-RCT Review	100 MMBO	304 MMBO	610 MMBO
Joint Post-RCT Review	185 MMBO	426 MMBO	693 MMBO

Table 13 – Summary of Approximate Recoverable Volumes at Shenandoah by APC Team after the Shen-4 well.[622]

689. In January 2016, a Shenandoah Fault Block Resource Assessment explained revisions to Exploration's resource assessment using the new methodology.[623] In a slide entitled "Historical Resource Ranges," the presentation compared pre-Shen-4 Exploration and post-Shen-

[620] APC-00059196.

[621] APC-00663563.

[622] APC-00663564. However, it appears that leading up to the RCT, the teams were continuing to update their post-Shen-4 estimates. *See* APC-00059603 ("I will say that exploration still carries pre-Shen 4 volumes, but they anticipate reducing each of their cases by about 20% once they have integrated the results."). Different assessments from around this time contain slightly different ranges. *See, e.g.*, APC-01166304.

[623] APC-01166304.

4 Exploration ranges.[624] The slide prior, entitled "Resource Ranges," compared Exploration's post Shen-4 range with the post-Shen-4 joint fault model resulting from the RCT.[625]

690. The Development team used the post-RCT numbers in the Shen-5 AFE and presented those numbers to management.[626] The Development team also contributed the economics for the next Company-wide portfolio update.[627]

2. Structure Mapping

691. Each of the Shen-4 wellbores and the data collected from them drove an evolution of the interpretation of the faulting in the western area of Shenandoah. The evolution of Anadarko's Exploration team's fault mapping through the different wells that were drilled at Shen-4 (*i.e.*, the original hole, the first sidetrack, and the bypass well) is depicted in the Figures below.

[624] APC-01166304 at slide 10.

[625] APC-01166304 at slide 9.

[626] APC-00667721.

[627] APC-00070330.

CONFIDENTIAL

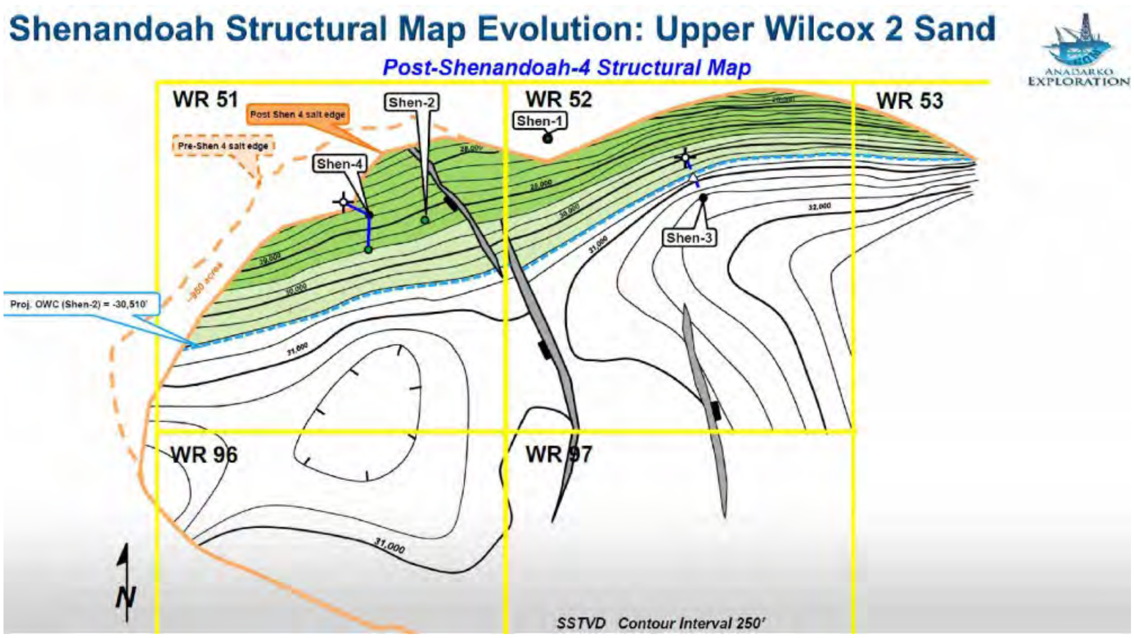


Figure 75 – Anadarko Exploration mapping after Shen-4 encountered salt.[628]

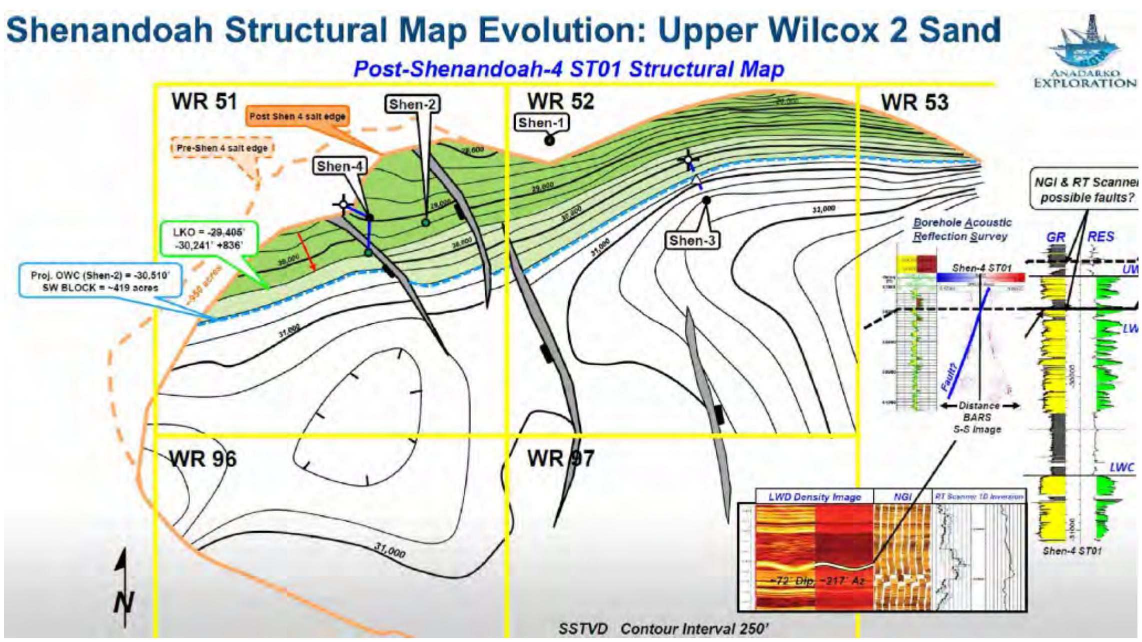


Figure 76 – Anadarko Exploration mapping after Shen-4 ST1 encountered 622 net feet of pay in Lower Wilcox sands.[629]

[628] Marathon_011477 at slide 13.

[629] Marathon_011477 at slide 14.

CONFIDENTIAL

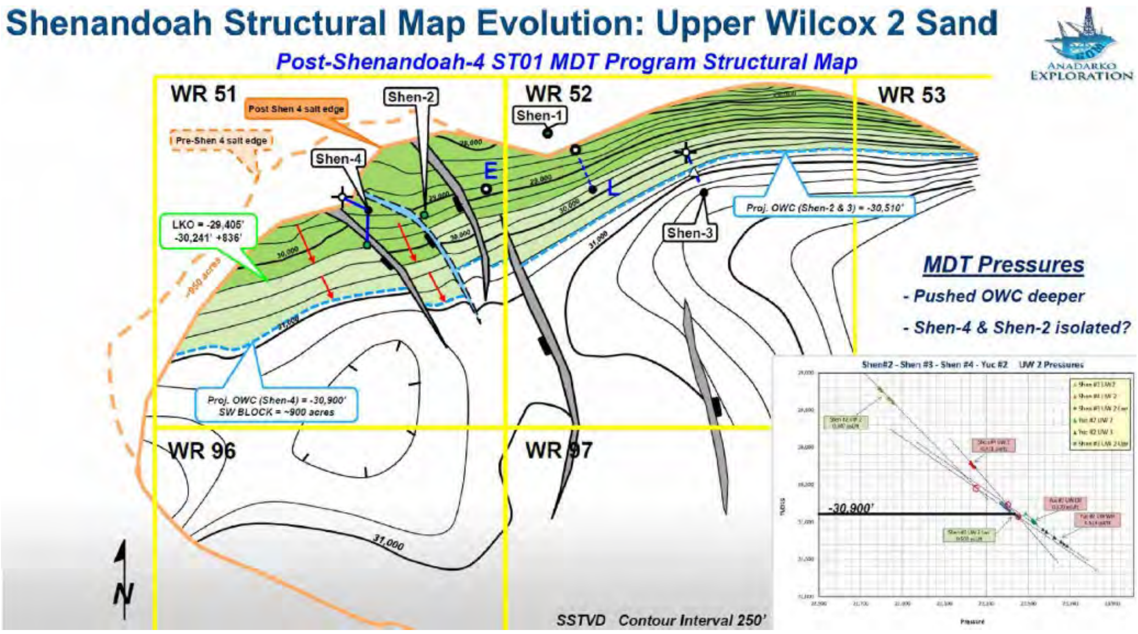


Figure 77 – Anadarko Exploration mapping after Shen-4 ST1 MDT measured pressures indicated that this was not connected to Shen-2 and that the OWC in this fault block was deeper than that at Shen-2, giving rise to an interpreted fault between them.[630]

692. At and after the October 2015 partners meeting, the partners shared maps that all showed complex faulting in the western portion of the field, with the partners being in agreement that differences in the Shen-4 ST1 and Shen-4 ST1 BP were indicative of faulting at the oil reservoir level, and that the Shen-4 ST1 oil was pressure separated from Shen-2 oil.[631]

693. The principal elements of faulting were agreed upon by partners. Partners agreed on the "E" location for Shen-3 appraisal/development well. For instance, ConocoPhillips' top sand map post-Shen-4 ST1 BP showed the same principal elements of faulting as agreed upon by the partners—*e.g.*, Shen-1 is separate from Shen-2 via pressures and penetrated OWCs in Shen-1; Shen-2 oil is separate from any potential Shen-3 up-dip oil via seismic mapping of discontinuity;

[630] Marathon_011477 at slide 15.

[631] Marathon_011477 at slides 20, 30, 48, 68.

Shen-4 ST1 oil is separate from Shen-2 oil via different pressure gradients measured in each oil column; and Shen-4 ST1 Upper Wilcox is faulted out from well logs.

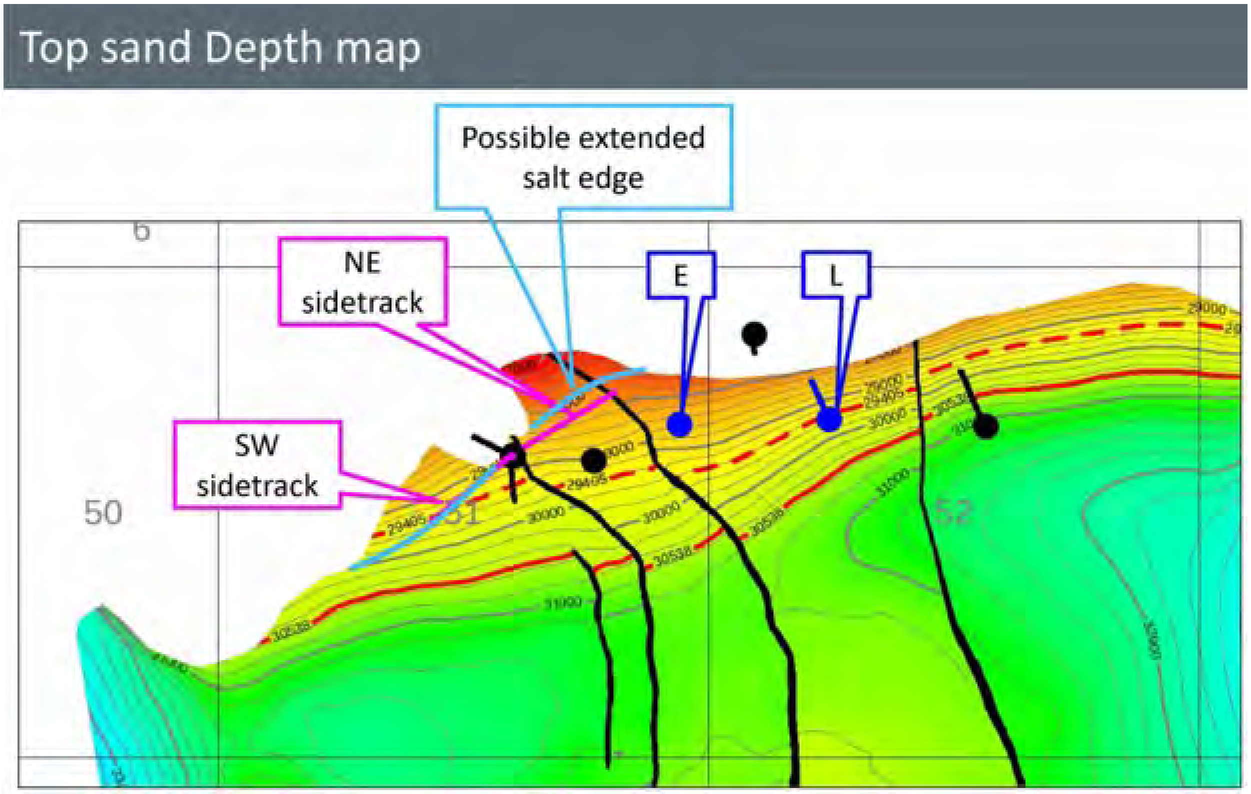


Figure 78 – Top sand map from ConocoPhillips post Shen-4 ST1 BP (October 2015). Note that the estimated OWCs in each fault block (except Shen-1).[632]

694. The January 2016 presentation titled "Shenandoah Fault Block Resource Assessment" reflects that Anadarko Exploration's post-Shen-4 map includes faulting similar to that of the Development team.[633] As noted above, around this time, Anadarko's Development team began engaging the partners and working towards defining the path to MEFS and project sanctioning.

[632] Marathon_011477 at slide 62.

[633] APC-01166304.

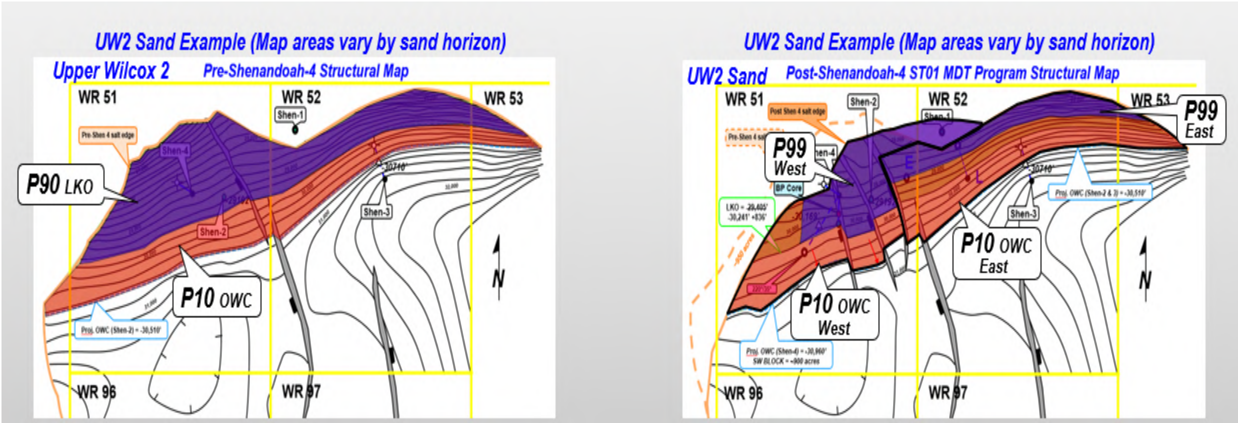


Figure 79 – January updates to Anadarko's Exploration mapping methodology post Shen-4. [634]

695. At the March 2016 partners meeting, Anadarko Development presented their updated structure map. It contained the same important elements as Exploration's map and shared common elements with partners' maps.[635] By this point in the appraisal the partners were mostly in agreement regarding their fault interpretations. A comparison of the faulting between the partners showed 75%-100% agreement on these important structural elements.[636]

[634] APC-01166304 at slide 4.

[635] Marathon_013736 at slide 36.

[636] APC-01193461 at slides 62-64; *see also* **Figure 84**, below.

CONFIDENTIAL

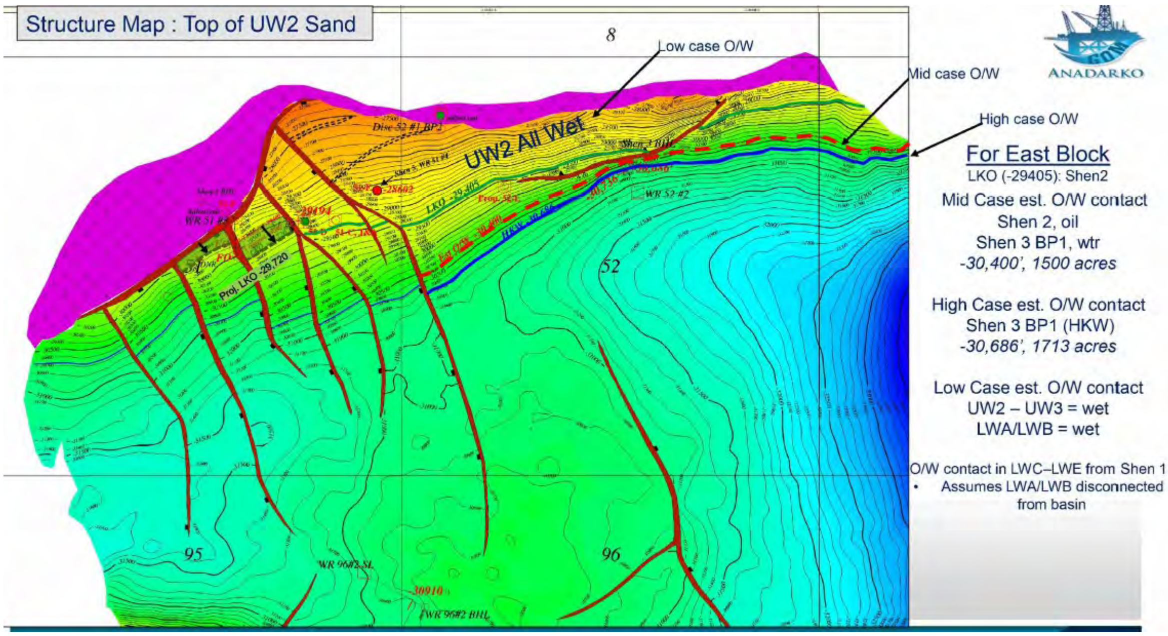
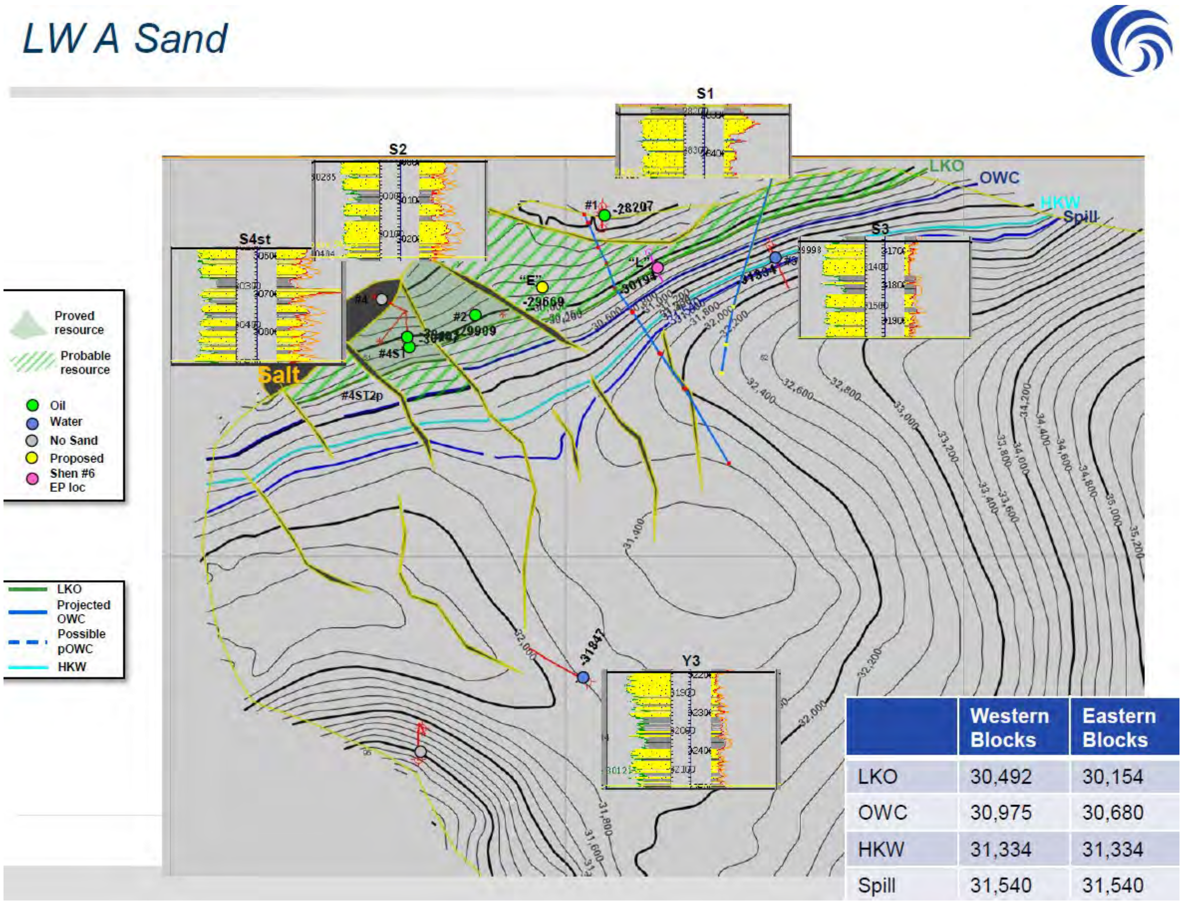


Figure 80 – Anadarko Development structure map presented at March 2016 Partners' Meeting. The major structural fault elements are consistent with both Anadarko Exploration and partner interpretations.[637]

[637] Marathon_013736 at slide 36.

CONFIDENTIAL



	Western Blocks	Eastern Blocks
LKO	30,492	30,154
OWC	30,975	30,680
HKW	31,334	31,334
Spill	31,540	31,540

Figure 81 – Cobalt map post-Shen-4 ST1 and BP but before drilling Shen-5 at "E" location (in yellow).[638]

638 APC-00066042 at slide 16.

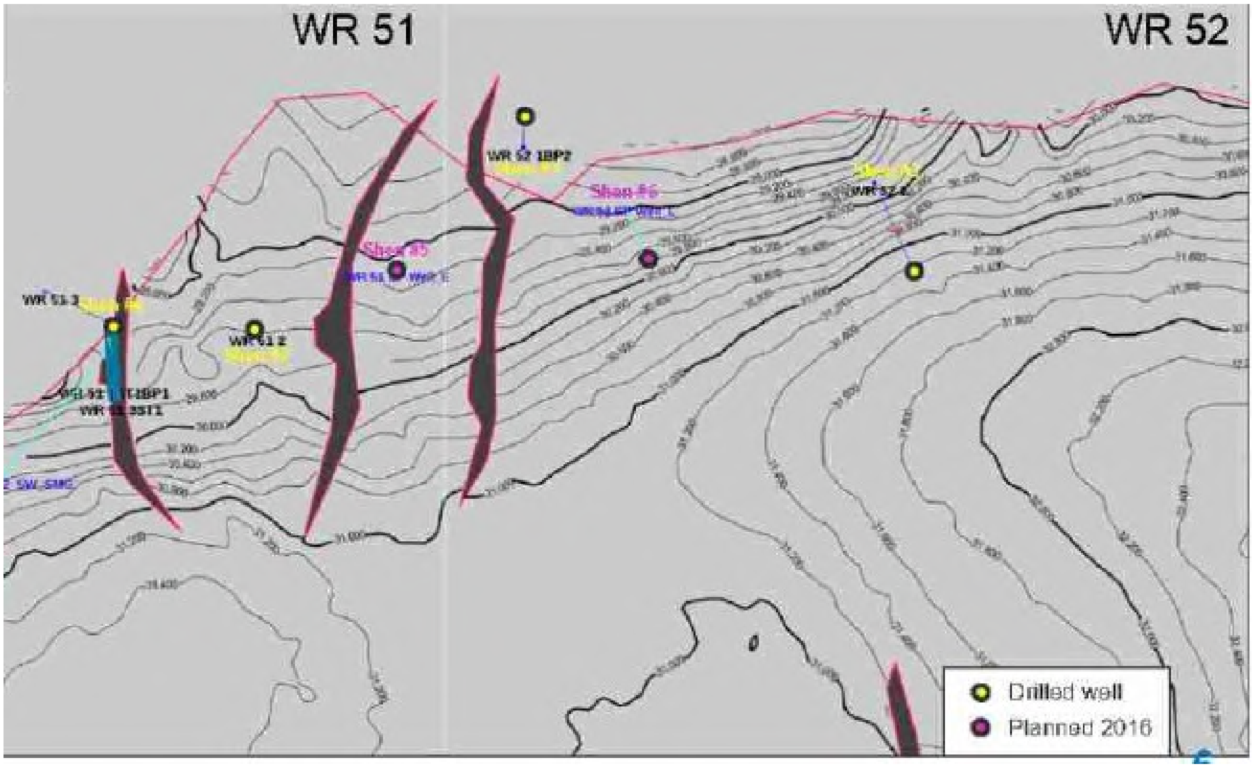


Figure 82 – Marathon map post-Shen-4/ST1/BP before drilling Shen-5 at "E" location (in purple). Marathon's faults are positioned differently but have similar predicted effects on connectivity.[639]

[639] Marathon_014240 at slide 6.

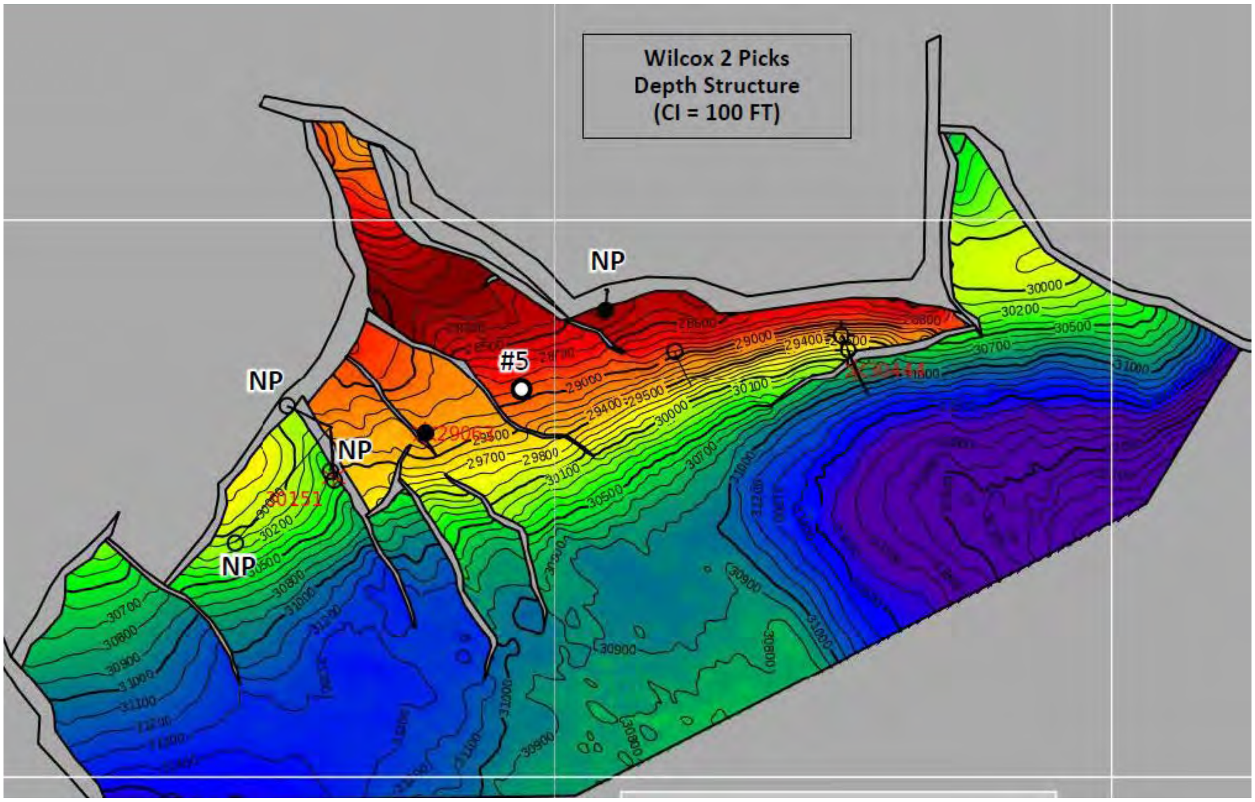


Figure 83 – Venari map post-Shen-4/ST1/BP before drilling Shen-5 at "#5" location. Venari's faults are in close agreement with Anadarko's and ConocoPhillips' fault interpretations.[640]

[640] APC-00066032 at 4.

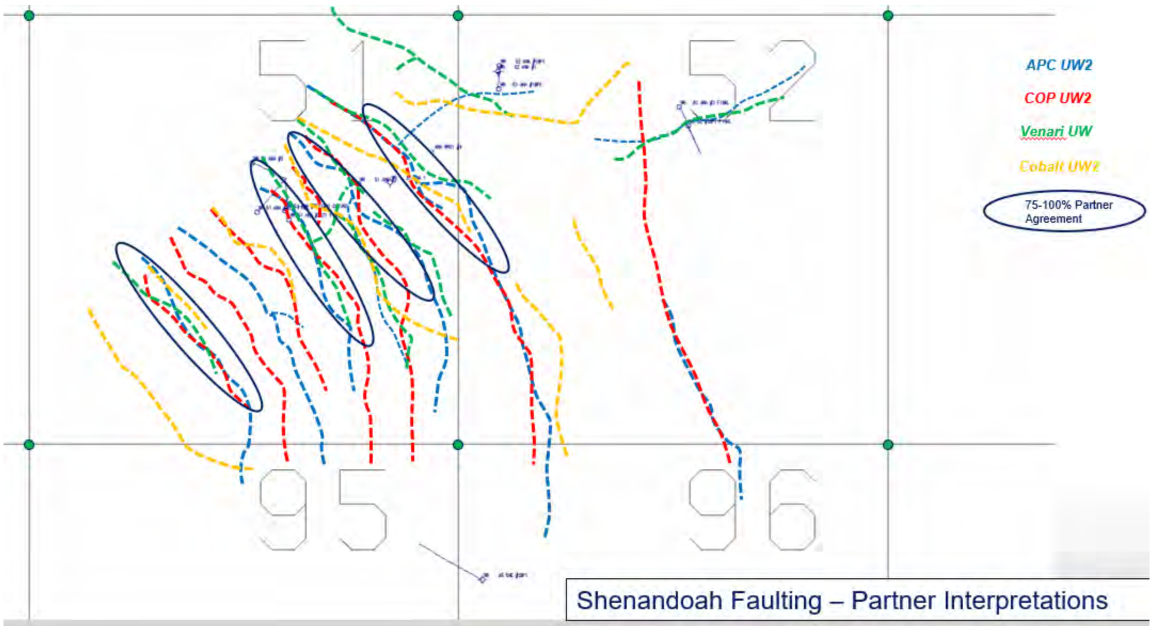


Figure 84 – A May 3, 2016 comparison of Anadarko mapped faulting with partner mapped faulting showing 75%-100% agreement in the interpreted location of the faults across the partnership before the drilling of Shen-5.[641]

696. Anadarko continued to project OWCs based on Shen-3 pressures after drilling Shen-4. Shen-4 ST1 and Shen-4 ST1 BP penetrated oil sands filled to base, but with oils at a different pressure gradient from Shen-2. This, plus direct evidence of faulting in the wells, implied a fault separating the Shen-4 ST1 well from Shen-2. However, the higher pressures in Shen-4 ST1 also implied a deeper projected OWC for the Shen-4 ST fault block than that at the Shen-2 fault block. This was true whether one used the water pressures from the Yucatan-2 well or the Shen-3 well, which varied from each other by a small amount. Following the drilling of the Shen-4 series of wells, Anadarko's Development team continued to use Shen-3 water pressures to project oil-water contacts in each of the fault blocks that had been discovered at Shenandoah, as illustrated in **Figure 85** below.

[641] APC-01193461 at slide 64.

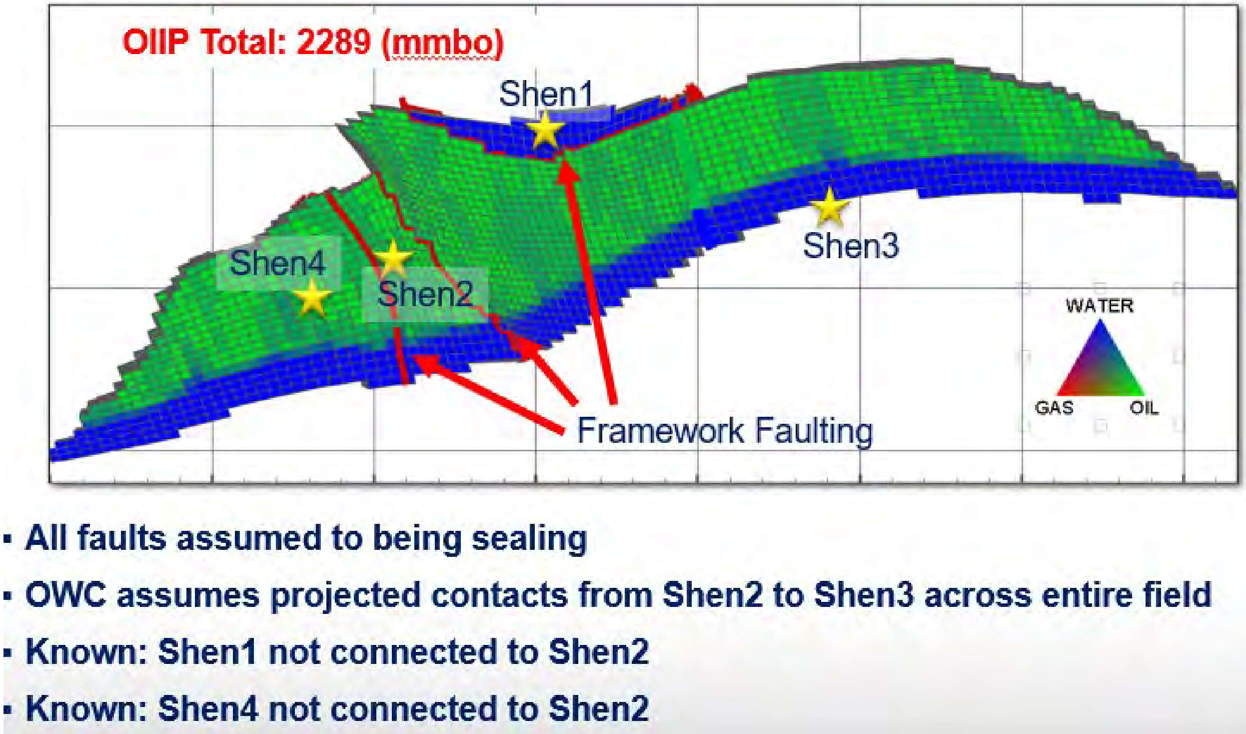


Figure 85 – Anadarko Development reservoir modeling post Shen-4/ST1 appraisal well indicating that differing oil pressures in Shen-4 ST1 and Shen-2 must indicate a fault separating the oil columns. However, the interpretation of a common downdip aquifer allowed Anadarko Development to continue to use pressures in Shen-3 to project OWCs in each fault block across the basin.[642]

3. <u>Alleged Misstatements</u>

a. *Amended Complaint ¶ 109: "[Shenandoah-4 was] a successful appraisal test . . . ." and ¶ 119: "[Shenandoah-4 contained] successful wells"*

697. The same discussion above about what it means for an appraisal well to be "successful" applies equally to these statements about Shen-4.

698. As with Shen-3, the entire complex of wells at Shen-4 were drilled safely, with no environmental concerns, and a tremendous amount of data about the western edge of the field was gathered. The data allowed for the reduction of uncertainties in the extent of the reservoirs and for additional rock and fluid evaluations to be made.

[642] APC-00053661 at slide 2.

699. Likewise, the Shen-4 wells were successful in the sense that they accomplished their pre-drill objectives. The Shen-4 Pre-drill objectives and desired outcomes were set by the Shenandoah partners as follows:[643]

- "Prove-Up Significant Hydrocarbon Rock Volume West of Shenandoah 2
  - *Based on APC mapping 45% of closure area (1,750 out of 3,875 acres) lies to the west of Shenandoah 2 Shenandoah 4 is positioned to test the area of greatest 'volumetric uncertainty'*
- Obtain Information for Commercial Planning
  - *Further constrain discovery resource range*
  - *Prove-up a minimal commercial field size*
  - *A step closer to getting 'off the clock'*
  - *Well results will assist in defining an optimal location for Shenandoah 5 (a possible take-point well)*
- Acquire Conventional Core
  - *Currently lacking whole core from oil-saturated reservoirs*
- Provide Utility for Geological Sidetracking
  - *Establish Oil / Water Contacts*
  - *Deviate away from any Stratigraphic or Lithologic 'Surprises' if they Occur*
- Continue to Assess Lateral Continuity of Reservoir Sands
- Stratigraphic correlation between wells in basin indicate widespread sand deposition
- Evaluate Lateral Changes in the TST Thickness of Correlative Sand Bodies
  - *Some minor thickness variations noted between Shenandoah 2 & 3 due to 'sand body compensation'*
- Assist in 'Ruling Out' any Significant Reservoir Compartmentalization
  - *Do any 'sealing faults' exist between the Shenandoah 2 discovery & the Shenandoah 4 location?*
- Gather Additional Petrophysical & Fluid Information
  - *Are there lateral variations in reservoir properties?"*

700. Although Shen-4 resulted in smaller OOIP volume estimates and demonstrated increased structural complexity, the wells did find a significant oil column to the west of Shen-2, and provided valuable rock and fluid samples for evaluation, helping to reduce uncertainty and progress towards a Development sanctioning decision.[644] Shen-4 encountered 622 net feet of pay,

[643] APC-00001146 at slides 80-82.

[644] APC-00058398 at slide 5.

defined the NW basin edge, extended the lowest known oil by 300 to 500 feet, defined an untested fault block, and helped refine the resource range.[645] It provided important information to drive commercial planning, as it suggested the "[p]otential for structural [c]omplexity on East Flank."[646] It identified pressure separation between Shen-4 ST and Shen-2, which implied a fault between the two oil columns but also lowered the Lowest Known Oil level on the west side of the field.[647] Subsequently, Shen-4 ST's interpreted pressure connectivity through the downdip aquifer to the Yucatan-2 well was used to project a Shen-4 ST downdip OWC.[648] Conventional Core in the oil-leg was successfully collected and demonstrated significant sand deformation and evidence of nearby faulting: "Numerous wide clusters of bands, which is different from the Shen 3 core, indicating enhanced levels of (shear) strain and closer proximity to major faults."[649] Rock and fluid sample enabled detailed analysis, including "Asphaltene Onset Pressure Tests."[650]

701. The Shen-4 appraisal successfully addressed significant uncertainties and delivered results that met the objectives of the partnership. Deposition testimony reinforces this. While Chip Oudin did not view the original hole as a success since it did not encounter the reservoir,[651] he viewed Shen-4 as a successful appraisal "in the sense it helped identify the . . . northwestern extent of the Shenandoah oil accumulation by definitively telling us where it wasn't. And then

[645] APC-00001935 at slide 6.

[646] APC-00058398 at slide 5.

[647] APC-00001935 at 6.

[648] ANACOP00007468 at slide 5.

[649] APC-00057872 at 13.

[650] *Id.* at 24.

[651] Oudin Dep. Tr. at 192:12-193:7.

sidetracking . . . and finding oil in the majority of the reservoirs that we'd encountered with the Shen 2." [652]

702. Even if the Shen-4 OH did not accomplish all the appraisal's objectives, it did provide valuable data and allowed for multiple sidetracks to be built. For one, the Shen-4 OH did successfully define the up-dip edge of the reservoir and reduced the uncertainty in western volumes. And the Shen-4 Sidetrack 1 found 622 feet of net oil, raised concerns with lateral continuity and provided valuable fluid samples. The Shen-4 bypass provided valuable core for evaluating reservoir performance and evaluating structural complexity. Overall, the Shen-4 well was a successful appraisal well.

b. *Amended Complaint ¶ 110: "[Shenandoah-4] was all oil, we encountered no water in that."*

Amended Complaint ¶ 113: "[Shenandoah-4] found over 620 feet of oil pay full [to] base."

703. Free water is water that separates from oil rapidly, and that is not chemically bound to the rock or mineral with which it is in contact. Every oil reservoir has a certain level of water saturation that is determined by the water's interaction with the rock grains and pore space. This water is "bound water" and will not flow, as opposed to "free water" that is not bound to an inorganic surface and that can flow freely. A "free water level occurs where the buoyancy pressure is zero in the reservoir-aquifer system. It defines the downdip limits of an [oil] accumulation."[653] This is what is referred to as an Oil-Water Contact (OWC). Pressure data taken within the water reservoir is the most reliable way to confirm the existence (density) of free water based upon its pressure gradient. Petrophysical information can also be used to estimate the level of water

[652] *Id.* at 244:25-245:12.

[653] AAPG Wiki – *Free water level determination using pressure*.

saturation in the reservoir using Archie's equations but cannot easily distinguish between "free water" and "bound water." Thus, when one refers to a well as being "all oil" or as being "full to base", they are implying that no "free water" level (OWC) has been penetrated by the well.

704. Further, it is noteworthy that from context it is clear that the speakers (Mr. Gwin for ¶ 110 and Mr. Leyendecker for ¶ 113) are referring specifically to the Shen-4 ST1 borehole when making this statement, as opposed to the other boreholes (*i.e.*, Shen-4 OH, Shen-4 ST1 BP, Shen-4 ST2). The Shen-4 ST1 well found a series of Lower Wilcox sand reservoirs filled with oil totaling 620 feet in Shen-4 ST1 and 473 feet in Shen-4 ST1 BP.[654] The initial logging runs did not provide conclusive evidence for interpreting producible oil in the poorly developed Lower Wilcox D (LWD) sand, and only clearly detected producible oil in the upper part of the LWE sand (based upon resistivity logging while drilling). This raised uncertainties while drilling regarding whether the LWD sand was wet and if the LWE sand penetrated an OWC.[655] A complete petrophysical analysis of these two sands using logging and core analysis data <u>did not</u> interpret either of these zones as having any free water.[656] By their December Partners' Meeting, the LWE sand had been determined to not have penetrated an OWC,[657] and by the June 2016 Subsurface Meeting,[658] there was no water shown in the LWD or LWE sands in either the Shen-4 ST1 or Shen-4BP well interpretation cross sections. Ultimately, once all data had been assembled and interpreted, the Shen-4 ST1 was interpreted as being "all oil" with each sand being "full to base," and no OWC

[654] APC-00002305 at slide 11.

[655] *See* APC-00196456.

[656] *See* APC-00002305 at slide 11.

[657] APC-01006587 at slide 13.

[658] APC-00077434 at slide 5.

penetrated. Instead, the downdip OWC at Shen-4 ST was projected deeper based upon the water pressure information collected from Yucatan-2.[659]

705. The Lower Wilcox D sand was "wet" in Shen-4 Sidetrack 1.[660] This sand was of much poorer quality and considerably thinner that the D-sand penetrated in Shenandoah wells located to the east.[661] However, the Lower Wilcox E-sand, located deeper than the D-sand, contained 65 net feet of oil.[662] This left considerable uncertainty associated with what was seen in the D-sand, as it could either be 1) poor quality rock with high water saturation (*e.g.*, >50%), or 2) above the OWC for the D-sand in this fault block, or 3) perched water trapped within a D-sand compartment. None of these possibilities had any significant impact on the sand correlation to Shen-2, or on the assessment of the other oil sands that were penetrated with Shen-4 ST1 (a total of 622 net feet of oil). One would not necessarily consider encountering this "conditionally wet" sand as having penetrated "free-water." Therefore, although this sand was initially interpreted as "wet" in this well, the presence of oil above and below, the poor quality of the "wet" sand, and a more thorough petrophysical analysis led to a final interpretation that indicated that "no [free] water" was encountered.

c. *Amended Complaint ¶ 110: "The reservoir quality in the initial assessment [of the Shenandoah-4 well] . . . looks comparable to everything else we've found out there. So very good reservoir quality."*

706. As noted above, "reservoir quality" generally refers to the size, porosity and permeability of the reservoir, and the reservoir quality for the Shen-2 and Shen-3 wells was

[659] APC-00002305 at slide 11.

[660] *See* Camden Dep. Tr. at 153:22–153:13; Exhibit 162 (APC-00196456) at 2.

[661] APC-01166304 at 16.

[662] APC-00001935 at 6.

excellent. The oil sands encountered in Shen-4 ST averaged initially assessed porosities of 18-22% and permeabilities of approximately 50 mD,[663] which is very good quality reservoir and comparable to the oil sands encountered in the Shen-2 well. The quality of Wilcox reservoir sand has a direct impact on the field's recovery factor and on a well's production rates.

707. Comparison of Shenandoah's reservoir and fluid properties to other Gulf of Mexico fields' Lower Tertiary Wilcox discoveries demonstrated the "good quality" of the Shenandoah reservoirs and fluids. This was confidently known within the Shenandoah partnership through scouted, purchased, and traded information for Petrobras' Cascade discovery in 2002 and Chinook discovery in 2003, soon followed by Chevron's St. Malo discovery in 2003 and Jack discovery in 2004, and by Shell's Stones discovery in 2005. This comparison was documented in an Executive Committee Meeting in 2016:

Wilcox Well Comparison							
	Jack	**St Malo**	**Cascade**	**Chinook**	**Stones**	***Shen 5**	***Shen 2**
GOR (scf/stb)	250	198	175	200	250	**1124**	**1261**
Viscosity	3.14	2.42	6.42	5.99		**1.32**	**0.89**
Pi (Psia)	19,318	19,526	19,149	18,826		**22,569**	**22,755**
Net Pay H	831	344	331	283		**1043**	**1001**
Avg Porosity (PHIE)	0.18	0.16	0.1	0.18	0.17	**0.199**	**0.211**
Avg Permeability (Kair)	32	17	30	66	30	**47**	**50**

Table 14 - Summary of properties of early Gulf of Mexico Wilcox discoveries.[664]

d. *Amended Complaint ¶ 110: "[Shenandoah-4] was well within the range of expectation of what we had put out there."*

¶ 112: "[O]n the resource range, we're right where we thought. We always do a probabilistic resource range. We're still in that range with the results of the [Shenandoah-4] well."

[663] 2015.12.02 - APC-01006587 at slide 13; APC-00002305 at slide 3.

[664] APC-00002305 at slide 71.

708. The first statement references the "range of expectations." The "range of expectations" for a well can refer to many different things. It can refer to the hydrocarbons encountered in a well but also reservoir quality. The statement also does not specifically reference resource "volume" ranges as the only expectation range being discussed. Ranges in reservoir quality (porosity, permeability) also fell within the expectation ranges.

709. The second statement references the "probabilistic resource range." As noted above, Anadarko's Exploration group projected a range of possible resource sizes internally. The statement does not clearly indicate what prior resource ranges are being referred to, and the Exploration group did not publicize resource estimates for particular discoveries, which make it difficult to assign any meaning to that reference.

710. To the extent either or both statements are interpreted as referring to Anadarko's internal resource estimates, these are objectively true statements. Any comparison of well results during the appraisal process would be to the information and resource ranges available immediately before the well was drilled. In other words, Anadarko would compare the post-Shen-3 ranges to the post-Shen-4 ranges.

711. Notably, these statements were made during an October 28, 2015 Earnings Call, soon after Shen-1ST1 completed drilling. Mr. Daniels declined to give an exact resource range and instead indicated that the results of the Shen-4 ST1 did not impact the estimates so significantly that they were no longer within the pre-Shen-4 range. This was correct—although the Shen-4 OH reduced the projected areal extent, those results would not suggest such a large difference in range. Moreover, this is objectively true when one compares Exploration's pre-Shen-4 resource range to either Exploration's post-Shen-4 resource range or the joint resource range that results from the January 2016 RCT. The joint Exploration and Development resource range reduced the P50

resources at Shenandoah from 740MMBO to 426MMBO.[665] The Development team shared a presentation with the full Executive Committee on February 1, 2016, that had a mean resource estimate for Shenandoah at 412.6 and 468 MMBOE for the risked and un-risked means, respectively, and an un-risked P10 estimate of 717 MMBOE.[666] The post-Shen-4 resource distribution was still within Exploration's resource distributions from prior to the Shen-4 well.

712. It is also important to keep in mind why the resource estimates changed. While the post-RCT change in methodology certainly had an impact on estimates, the in-place resource estimates were reduced primarily because of the Shen-4 OH results. Because the well drilled through salt in an area that was projected to encounter an oil column, Anadarko knew with reasonable confidence that anything to the north or west of that well did not contain oil, thus reducing the western extent of the field. In-place resource estimates were also negatively affected by the missing Upper Wilcox section, which removed the possibility of some reservoirs from the eastern region being present in the western region. Further, the cost of recovery of oil from the western area was negatively affected because of the demonstrated different oil pressures measured within the well indicated that oil was not laterally connected between Shen-4 ST and Shen-2 and might require additional wells to recover.

713. However, the in-place resource estimates were positively impacted by the fact that Shen-4 ST1 encountered oil deeper than where LKO had been projected into the western region from the Shen-2 well, adding downdip in-place volumes to the resource estimates in the Shen-4 fault block. Also, the rock and fluid properties were not materially different from those encountered in Shen-2 and Shen-3 wells.

---

[665] *See* APC-01314375 at slides 32, 55.

[666] APC-01167170 at slide 11.

4. Alleged Omissions

a. *¶ 95(h): "Shen 4 confirmed massive salt deposits that would obstruct or prevent access to deposits"*

714. "Salt" in the Gulf of Mexico is an evaporite deposit from seawater. "The rock record shows us that thick, basin-wide salt deposits accumulated in active rift, passive margin, intracratonic and even foreland basin settings, where there was the happy congruence of climate, isolation from regular and frequent access to normal seawater, and a negative water balance over geological time periods. However, salt, once deposited and buried, is highly mobile and prone to deformation, producing spectacular intrusive bodies such as diapirs which act as detachments in thrust belts. Salt tectonics also impacts depositional patterns and the geometry of strata in sedimentary basins."[667]

715. The sediments at Shenandoah were deposited in turbidite flows at the seafloor above the Luann salt before being intruded upon and subsequently covered by the highly mobile salt reacting to the sediment weight being deposited upon it.[668] Today, the entire Shenandoah basin is covered by a ~20,000 feet thick salt canopy that all wells must drill through. Drilling through salt in the Gulf of Mexico is a well understood and commonly practiced endeavor.

[667] AAPG Wiki from Hudec & Jackson, 2007; 2017.

[668] APC-01314375 at slide 71.

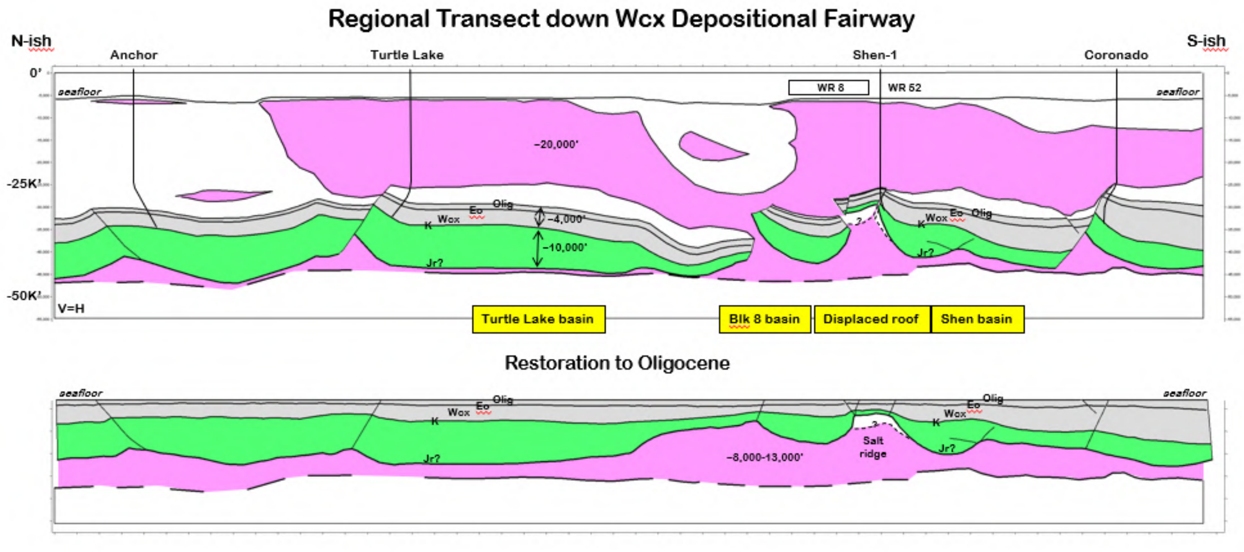


Figure 86 – Graphic indicating that deeper salt overrode the Lower Tertiary sediments burying them beneath a thick canopy of shallower salt.[669]

716. Plaintiffs are not clear about specifically what they mean by "salt deposit" and neither Merrill nor Pittinger's reports use the phrase. Based on my understanding a "salt deposit" that could "obstruct or prevent access to deposits" would have to have special characteristics that would have made it un-drillable with then-current technology. The salt canopy at Shenandoah likely does not fall into that category as it is a fairly uniform salt body without any exceptional drilling hazards.

717. Each and every Shenandoah well successfully drilled through "massive salt deposits"—namely, the 20,000-foot-thick salt canopy that overlies all the Wilcox sediment formations at Shenandoah from ~7,000 feet to ~27,000 feet in depth.[670] The salt does not "obstruct or prevent access" to the reservoir and the Shenandoah oil reservoir was successfully penetrated by Shen-4 ST through massive salt.

[669] APC-01314375 at slide 71.

[670] *See* APC-00348941 at slide 44.

CONFIDENTIAL

718. The original hole at Shen-4 drilled through salt on the western side of the field at a depth where they expected the oil-bearing reservoir to be, which reduced the size of the reservoir to exclude the area northwest of the well. The risk of this occurring was recognized prior to the drilling of the Shen-4 OH well by Anadarko staff.[671] Despite the risk of being too far up-dip and missing the sedimentary basin, the Shen-4 OH appraisal well was necessary to reduce the uncertainty regarding the up-dip limits of the Wilcox reservoir in the west. Without this information, the uncertainty range of potential in-place volumes was too large to design an appropriate development. In fact, one of the reasons that this appraisal well was designed to be sidetracked was because this risk was identified and accepted prior to approval of the well.

719. Anadarko reported that "the Shenandoah-4 appraisal well tested the up-dip extent of the basin. The subsequent Shenandoah-4 sidetrack encountered more than 620 net feet of oil pay, extending the lowest known oil column downdip."[672] This was accompanied by a map clearly showing the Shen-4 OH at the upper-most limit of the reservoir deposition, on the border between the reservoir and the salt canopy.

Figure 87 – Shenandoah map showing relative positions of Shenandoah appraisal drilling including the Shen-4 test at the western up-dip limits of the basin.[673]

[671] Oudin Dep. Tr. 182:21-184:5; Exhibit 131 (APC-00045640) at 1; Chandler Dep. Tr. 166:17-171:18; Exhibit 205 (APC-00188661) at 1.

[672] 2015.10.27 - Operations Report (Q3 2015) at 13.

[673] *Id.*

720. At the October 2015 Earnings Call, Anadarko reported, "What we ended up doing was we tested up to the north with trying to find out where the basin edge was. And the first well -- established where the basin edge was. Then we came in and drilled to the south with the sidetrack and got the 622 feet of pay," again indicating that the original hole found the "basin edge."[674] Since the "basin" is completely encased in salt, the "basin edge" indicates "salt."

721. Further, during a May 24, 2016, investor call, Anadarko shared the below map of Shenandoah that shows the Shen-4 OH drilled through salt at the target depth.[675] This same map is included in the Amended Complaint,[676] and however one interprets Plaintiffs' claim of a "massive salt deposit," which is addressed by neither of their experts, it is clear that Anadarko did, in fact, disclose that the Shen-4 OH drilled through salt.

[674] APC-00002831 at p. 7.

[675] Anadarko Presentation at UBS Global Oil & Gas Conference, May 24, 2016, p. 10.

[676] Dkt. 55 – Amended Complaint, ¶ 125.

CONFIDENTIAL

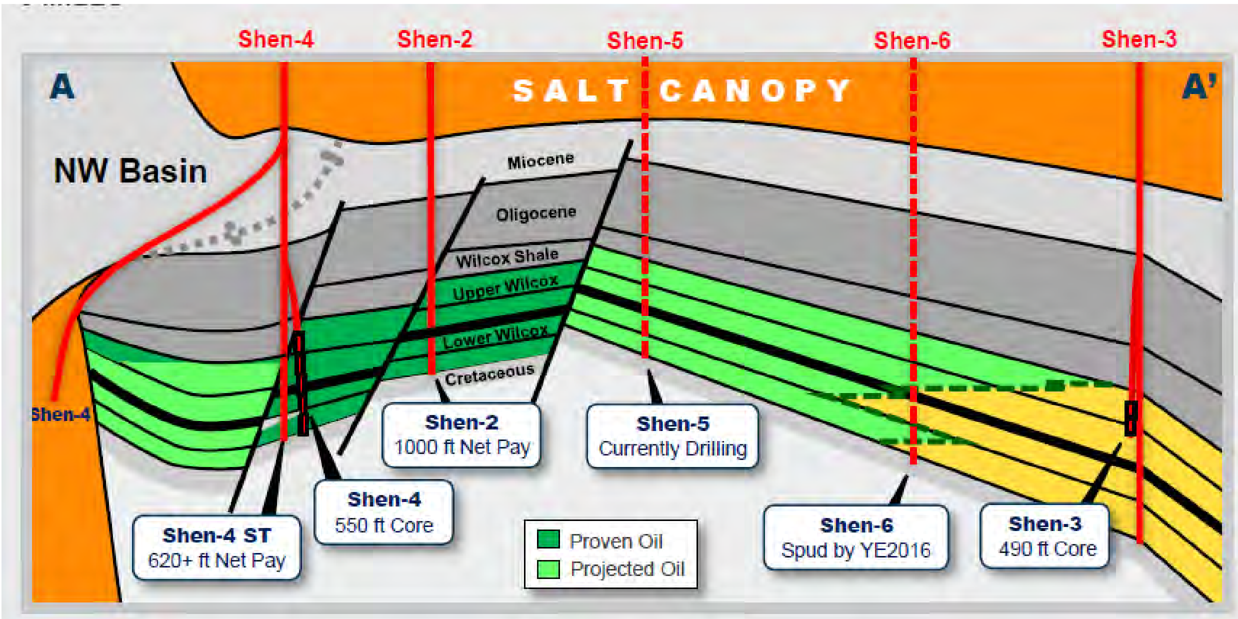


Figure 88 – Cross-section that was shown that clearly indicates that the original Shen-4 well drilled into salt.[677]

5. Rebuttal to Merrill Opinions re: Shen-4

722. **Merrill Opinion re: Shen-4:** As explained above, Merrill's assignment was to "analyze the scientific and technical data in the record about Shen in order to assist the fact finder in understanding the evidence and opine about the *adverse information* known to Defendants, leading up to and during the Class Period, about Shen's commercial viability and producible resource size."[678] With respect to Shen-4, Merrill highlights the reduced internal resource ranges, the risk of compartmentalization and faulting, which he says "posed a serious risk to Shen's producible resource size and commercial viability,"[679] and the tar encountered in one wellbore, which he says "posed a serious risk to the commercial viability of Shen."[680]

[677] Anadarko Presentation at UBS Global Oil & Gas Conference, May 24, 2016, p. 10.

[678] Expert Report of Robert Merrill, ¶ 3.

[679] *Id.* ¶ 18(c).

[680] *Id.* ¶ 18(e).

723. **Rebuttal to Merrill Opinion re: Shen-4:** Although Merrill emphasizes these negative outcomes, his assessment is incomplete. He fails to recognize the valuable information learned from Shen-4, the remaining uncertainty that Anadarko recognized would impact the commercial success of the project, and the efforts that Anadarko was taking to mitigate any risks. The entire goal of the appraisal program was to test and understand the reservoir and reduce uncertainties. I am not aware of any evidence that anyone at Anadarko concluded these risks and uncertainties made the project non-commercial. Rather, the evidence reflects that the project remained potentially economic and that Anadarko was considering ways to devise a development plan that properly accounted for the subsurface findings and remaining risks and uncertainties. I review the detailed statements from Merrill's report below.

724. **Merrill ¶¶ 66, 85:** "In the September 9, 2015 budget review, the issue of compartmentalization was highlighted by presenting both the exploration 'no fault' pre-Shen-4 map and the development 2014 map." "[The] September 9, 2015, Shen project Update & Preliminary Budget Review includes the recognition that there was a potential asphaltene issue that could affect production, documented differences in fault interpretation between Exploration and Development, and indicated the reduced area of hydrocarbon accumulation from the results of Shen-4. MMRA interpretation based on this division suggested a mean resource of about 400 MMBOE."

725. **Rebuttal to Merrill ¶¶ 66, 85:** Merrill looks to the September 9, 2015 Project Update. This Project Update[681] was done while Shen-4 ST1 BP operations were still underway. The presentation recognized three "Principal Challenges & Project Risks."[682] The first was

[681] APC-00193551 at slide 5

[682] *Id.* at slide 3.

effective clock management. This included maximizing the use of the 180-day clock, linking the SOP to the Development timing of 20K technology, and aligning with precedent that production would be established within five years of the SOP issuance. The second was defining commercially recoverable resources and MEFS. The presentation noted that this depended on the degree of lateral and vertical connectivity (impacting recovery per well), long term production performance, impact of high asphaltene onset pressures, and dealing with the complex completions due to multiple, thick, vertically-stacked sands. Finally, the third challenge was managing and sustaining partner alignment on all key decisions. Anadarko recognized that the "[r]esults of Shen-5 could condemn [the] project."[683]

726. Anadarko recognized the remaining uncertainty on the east side, listing the "major focus" as "East side delineation." [684] The presentation included Exploration and Development maps from before-Shen-4, as well as the updated Development map from after-Shen-4.[685] It is interesting to note that at least two of Development's mapped faults pre-Shen-4 were actually in the salt where the Shen-4 OH was targeted, again demonstrating the risk of putting speculative faults on a map.

727. Merrill's characterization of the meeting as having discussed "the recognition that there was a potential asphaltene issue that could affect production" is a mischaracterization of the meeting. The issue of asphaltenes appeared on a single line, in the midst of a single slide, among 43 slides – "Impact of high asphaltene onset pressures (11,000 -14,000 psi.)."[686] One would hardly characterize this as an issue which anyone believed was a serious roadblock. Additional evidence

---

[683] *Id.* at slide 4.

[684] Id.

[685] APC-00193551 at 12-15.

[686] APC-00193551 at slide 3.

discussed in this report[687] indicates that Anadarko sought to understand the nature of the asphaltene onset pressures and how to mitigate the risk of asphaltenes. Merrill ignores these efforts completely.

728. **Merrill ¶ 86:** "Additional seismic mapping and the drilling of Shen-4 revealed small-scale faulting in the Shen geologic structure. Geophysical mapping (Figure 28) noted several faults oriented NW-SE closely related to the lineations in the dip attribute map (coherence map), Figure 22, confirming that the 'lineations' were faults as recognized by the development team. The results of Shen-4 found significant evidence for faults summarized by Paul Chandler in (APC-01180902, slide 48). These faults are present in the March 2016 Paul Chandler PowerPoint cross-section shown in Figure 29. The list below highlights the evidence of faulting.

- Faults interpreted from wireline logs: NGI, RT Scanner, Density Image, BARS.
- Paleontology data indicated the Upper Wilcox Sands in Shen-2 are missing in Shen-4.
- Lower Wilcox Sands correlated to Shen-2, Upper Wilcox Sands missing.
- Lower Wilcox Sand pressures were different between Shen-4 ST and Shen-2.
- Slickenslides in the cuttings and cores indicated faults.
- Deformation bands were identified in the core.
- The fault zone was not a single plane and could be a cluster of parallel faults or a zone of crushed rock along a single fault."

729. **Rebuttal to Merrill ¶ 86:** Merrill claims that by the finishing of drilling of Shen-4, that there was a significant body of evidence for faulting at Shen-4. Merrill exaggerates the risk of faulting and inaccurately presents Development's interpretation as without flaws. As an initial matter, one of the objectives of the appraisal process was always to understand the extent and

687 *See* ¶¶ 49, 77-78, 91, 717.

impact of faulting. As explained previously, the issue has never been if faulting exists, but rather can one identify faulting confidently and can one put it on a map to guide the development planning. Importantly, while Merrill claims Anadarko "ignored faulting" at earlier points in the report, he ignores the fact that the Anadarko Development team took over the mapping and appraisal planning after Shen-4. Development mapped these faults and yet still determined that the project was likely developable and economic, drilling two keeper wells, Shen-5 and Shen-6.

730. Merrill overstates the evidence. The Shen-4 wells clearly penetrated one or more faults. The potential for faulting at Shenandoah had been recognized from the earliest wells. In fact, given how close Shen-4 Sidetrack and Bypass wells were drilled to the salt stock, it is no surprise that there is faulting in this extreme up-dip area. However, Merrill overstates the strength of the evidence. While he claims that "slickensides in the cuttings and cores indicated faults," Mr. Chandler testified that slickensides are indicative of movement along the two surfaces, which can also be caused by a fracture.[688]

731. More fundamentally, while Merrill suggests that geophysical mapping by the Development team had identified faults seen in the Shen-4 ST1 and Bypass wells, a comparison of Development's pre- and post-Shen-4 maps demonstrates that Development's faults were not accurate. (See **Figure 89**, below.) Development initially mapped the Shen-4 well in a defined fault block, but well results subsequently indicated that Shen-4 was in salt and the two southeast-northwest faults did not exist. Additionally, the Development team re-oriented and added additional faulting in the area based upon well control. By contrast, the Exploration team simply took a different approach, and avoided putting faults on maps unless they were strongly supported

[688] Chandler Dep. Tr. 188:14-189:3.

by data, taking into account the multiple independent interpretations of those working on the project.[689]

[689] *See, e.g.*, Marathon_004981 at slide 41.

CONFIDENTIAL

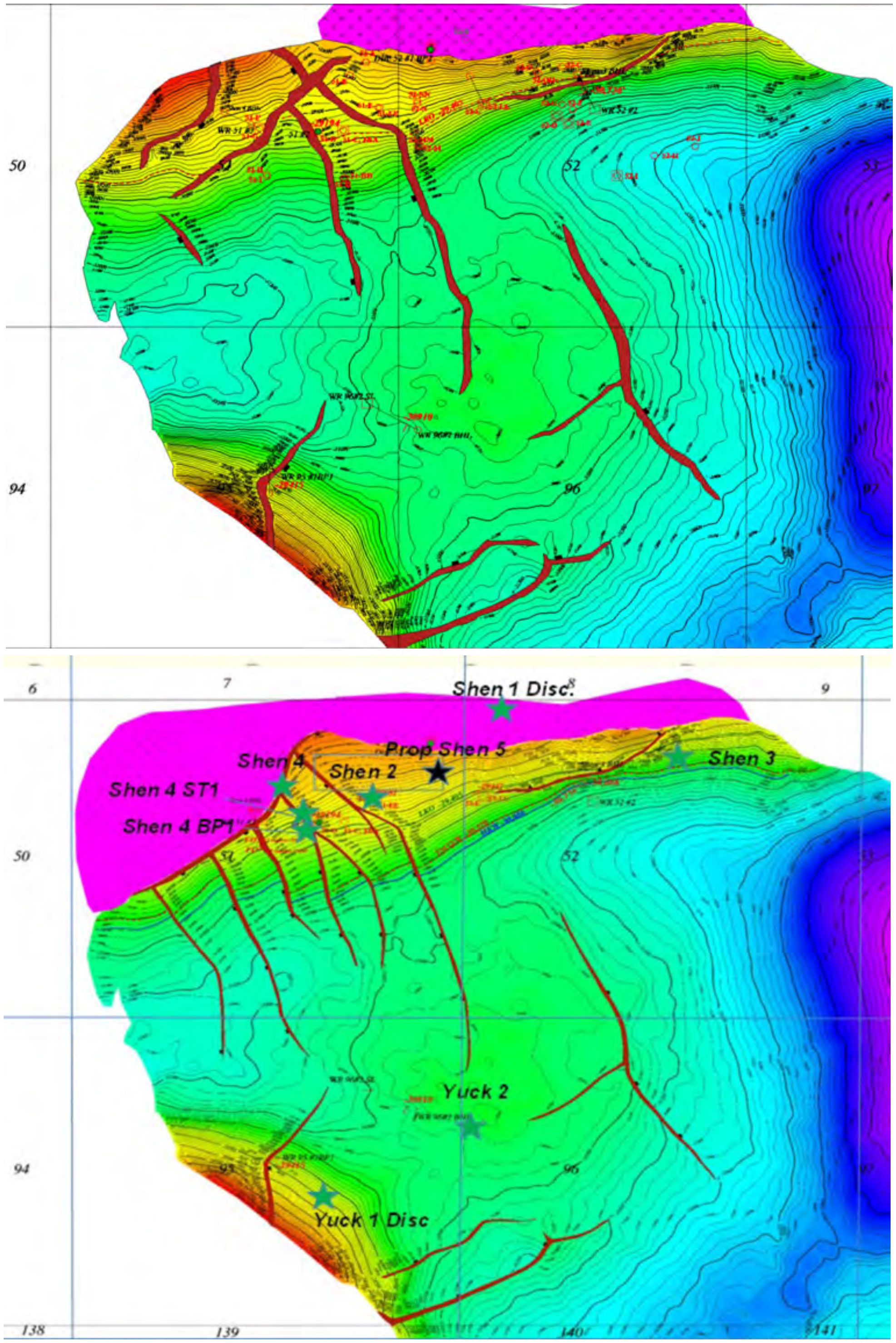


Figure 89 – Comparison of Anadarko Development team maps from before Shen-4 (top)[690] and after Shen-4[691] (bottom). Note the changes in the faulting in the northwest area.

732. **Merrill ¶ 87:** "Indeed, Paul Chandler observed that the fact Shen-4 potentially eliminated the entire Upper Wilcox in the reserve model was a 'huge implication at stake.' In his

deposition, Chandler stated that Anadarko 'hadn't found a full section of Upper Wilcox, so' it 'was a possibility' that 'the Upper Wilcox might be excluded from the reserve model.'"

733. **Rebuttal to Merrill ¶ 87:** Merrill mischaracterizes Mr. Chandler's statements. During his deposition, Mr. Chandler was asked to read an email he sent on November 5, 2015. In that email, Mr. Chandler discussed why he thought the Shen-4 ST2 was still important to drill. Mr. Chandler was concerned about the lack of certainty of the orientation of the fault encountered in the Shen-4 ST1 and Bypass wells where the Upper Wilcox was faulted out. The two possibilities that resulted from this were that 1) the fault was oriented in such a way that the Upper Wilcox was present but not seen in the wells, or 2) the Upper Wilcox was not present in this western area. Mr. Chandler supported the Shen-4 ST2 to help "answer many questions about the stratigraphic nature of the upper Wilcox and . . . determine if the entire upper Wilcox section should be excluded from our reserve model for a large area in the southwestern portion of the field. With such huge implications at stake, a southwest sidetrack to the southwest would be a prudent thing to do."[692] Mr. Chandler also noted that the Shen-4 ST would help determine if the faulted model was in fact valid.[693] Thus while it was a possibility that the Upper Wilcox would need to be excluded from the reserve model, no such decision had been made.

734. **Merrill ¶ 88:** "The fault and deformation bands identified in Shen-4 and the mapping further confirmed the likely compartmentalization of the Upper Wilcox suggested by previous wells. The development team assembled evidence that the Shen structure was not a simple homoclinal structure but that the structure was compartmentalized. These compartments or barriers would likely reduce hydrocarbon recovery factors."

---

692 Chandler Dep. Tr. 194:5-13.

693 *Id.* 193:20-194:13.

735. **Rebuttal to Merrill ¶ 88:** Merrill's opinion on the widespread impact of the faults and deformation bands is extreme and not supported by the data. The faults and small-scale deformation identified at Shen-4 were strong indications that Shen-4 ST1 and Bypass encountered a fault. Given the extreme up-dip location of these wells, the ability to extrapolate these results to all wells across the basin is a gross exaggeration. Merrill also opines that other wells suggest this same level of faulting—which is not true—and that this fault at Shen-4 somehow was evidence of compartmentalization of the Upper Wilcox across the Shenandoah field—another extreme exaggeration. Several of the faults on the Development team's maps were proven to be inaccurate representations of the subsurface; other faults, following the drilling of Shen-6, would be found to be inaccurate as well. Merrill is correct that some compartments—if small—would likely reduce recovery factors. However, the Development team accounted for this uncertainty by conducting their modeling at lower recovery rates.

736. Merrill does not account for the variety of types of faults that were present or possible in the area. Faults that seal 100's of psi pressure differential while the field is in equilibrium may not seal when the field undergoes production and pressure differentials of 1000's of psi are generated. It is not unusual in Deepwater Gulf of Mexico for faults to begin to leak based upon the drawdown that the reservoir experiences. Mr. McGrievy testified that even a sealing fault "can break down over time due - due to pressure depletion" and "you can start producing it."[694] Merrill's analysis fails to account for these complexities.

737. **Merrill ¶ 89:** "The potential for North-South faulting impacted the uncertainty in resource size because the Shen structure is elongated along an East-West axis with sealing North-South faulting, each potential fault block would need to be tested, and extrapolations of oil and

---

[694] McGrievy Dep. Tr. 116:22-117:1

aquifer gradients located miles apart would be invalid to determine the depth of OWC's. Figures 30, 31, and 32 resulted from interpreting 2016 reprocessed seismic data and clearly show fault compartmentalization."

738. **Rebuttal to Merrill ¶ 89:** As discussed in my rebuttal to Pittinger ¶ 31, which contains substantially the same language as Merrill's ¶ 89, this opinion relies heavily upon the benefit of hindsight, and demonstrates only that the risk of faulting remained a significant uncertainty that Anadarko was testing through the appraisal process.

739. The maps Merrill cites were made in 2017 with the benefits of improved seismic data and well data from the Shen-5, Shen-6 and Shen-6ST wells. Merrill admitted during his deposition that it is "normal to reprocess seismic using different algorithms again to try to improve the image," and "in this case, that 2016 reprocessed seismic indicated – confirmed that Shen 1 was separated by fault from Shen 3, Shen 2, and so forth."[695] Moreover, even Merrill recognizes the uncertainty in the placement of faults on these maps by referring to the "potential" for north-south faulting. Even the newest seismic that he references has faults interpretations that are highly uncertain.

740. Merrill overstates the risks of faults. While Merrill opines that the potential for faulting impacted the uncertainty in resource size, the risk of faulting actually impacts recoverability and the Development plan. Faults do not prevent you from recovering oil. Anadarko employees recognized this: for example, Mr. Strickling testified that even if there were faults, that they would not prevent "you from recovering . . . [oil]."[696] While Merrill testified that with faulting, Anadarko would have to drill additional wells to explain the uncertainty, and "if you

[695] Merrill Dep. Tr. 195:25-196:6.

[696] Strickling Dep. Tr. 218:10.

have to drill too many wells and you're not going to produce enough hydrocarbons, it's not a commercial well – it's not a commercial enterprise."[697] It is true that these interpreted faults are drawn on the map, and, if they exist and are sealing, would have independent OWCs. However, each block would not need to be tested for its OWC as the best producing location for each fault block is up-dip, and Development wells would simply be positioned to drain the largest blocks. The production profiles of the wells would identify where the OWC had been. Many of the OWCs drawn on these maps are drawn at the same contour on either side of the fault implying that not all of these faults are being interpreted as sealing, particularly the downdip Shen-5 fault block and eastern fault blocks.

741. While Merrill again argues that water pressures measured in one well cannot be used to estimated OWCs in a well in another fault block, this is not true. The north-south faulting interpreted at Shenandoah only separated the oil columns of each fault block, but did not necessarily seal the oil from a common downdip aquifer. For the pressures in any well's water leg to be inappropriate for projecting OWCs, the water would have to be compartmentalized and thus, within a different pressure regime. The interpreted faulting and measured pressure showed no evidence of that. Although the "pink" potential north-south fault was sometimes interpreted as extending into the basin center, Anadarko and all of their partners continued to use water pressures to project most likely OWCs across the field.

742. **Merrill ¶¶ 41, 90, 91:** "The impact of flow barriers increased in importance with the finding that asphaltene dropout pressures ('AOP's) were relatively high. Wellbore pressure maintenance is required by substantial aquifer support or water injection to prevent the premature

[697] Merrill Dep. Tr. 60:10-25.

dropout of asphaltenes in the reservoir. Asphaltenes negatively impact crude oil production because they may precipitate out in the reservoir, seriously decreasing the production rate."

743. **Rebuttal to Merrill ¶¶ 41, 90, 91:** Merrill's concerns with asphaltenes are overexaggerated. Although asphaltenes are present at Shenandoah, this is not surprising as these types of fluids are not rare in the production of deepwater Gulf of Mexico fields. In fact, asphaltenes are a relatively common issue that has been dealt with in GOM deepwater developments for over twenty years by Anadarko and others, including, for example, Typhoon,[698] K2,[699] and Blind Faith.[700] For example, the authors of a 2017 paper stated that "[d]eepwater fields, such as those encountered in the Gulf of Mexico (GoM), often exhibit reservoir tar deposits and asphaltene instability."[701]

744. Anadarko has had previous experience with dealing with asphaltene issues in the Gulf of Mexico at their K2 development.[702] They had long known that all deepwater developments need to deal with a variety of flow assurance issues, of which asphaltene is one. In 2008, authors at Anadarko wrote the following:

> "As in all deepwater offshore development projects, standard procedures for systematic flow assurance studies and risk mitigation (Jamaluddin et al. 2001) were implemented for the initial K2 field development. Initial development of the K2 North field (GC Block 518) operated by Anadarko, included several aspects of flow assurance from the bottom of the well to the subsea tree to the top-sides equipment. These included the following aspects and their corresponding mitigation strategies:

---

[698] SPE 84147, 2003, Ring, et. al., "Management of Typhoon: A Subsea, Deepwater Development."

[699] Offshore Technology Conference OTC 19624, 2008, Lim et al., " Design and Initial Results of EOR and Flow Assurance Lab Tests for K2."

[700] Offshore Technology Conference OTC 21587, 2011, Montesi, et al., "Asphaltene Management in GOM DW Subsea Development."

[701] Offshore Technology Conference OTC 27826-MS, 2017, Asphaltene Onset Pressure Uncertainty, H. Dumont, et. al., p. 1.

[702] Offshore Technology Conference OTC 19624, 2008, Lim et al., Design and Initial Results of EOR and Flow Assurance Lab Tests for K2, Frank Lim, Eulalia Munoz, and Brad Browning.

- Hydrate formation
- Paraffin deposition
- Slugging potential
- Scale and Corrosion
- Asphaltene deposition"[703]

745. To avoid problems associated with asphaltene precipitation or deposits, mitigation plans are put in place. These can be as simple as designing a development plan and production system that keeps the oil above its AOP (by limiting drawdown or ensuring pressure support is maintained), and/or keeps the oil warm enough that dropout of asphaltenes does not occur in the production equipment. Chevron discussed these mitigation techniques as they were considered for their development at Blind Faith: "Proposed mitigation techniques include pipe coatings and continuous asphaltene inhibitor (dispersant) injection to stabilize asphaltene particles in the production fluid by minimizing agglomeration. Remediation techniques include regular solvent soaking, bullheading, and mechanical cleaning."[704]

746. Chevron also noted their mitigation techniques at the Typhoon Development where "[a]s a precaution, the tubulars were coated with a phenolic coating"[705], and "[u]pon completion, the wells were equipped with downhole chemical injection to mitigate asphaltene deposition and bottomhole pressure gauges for improved well management."[706]

747. If asphaltene dropout does occur in the production system, it can also commonly be addressed with chemical injection. Anadarko also had experience with this issue at their K2

[703] *Id.* at p. 3.

[704] Offshore Technology Conference OTC 21587, 2011, Asphaltene Management in GOM DW Subsea Development, Montesi et. al., p. 2.

[705] Offshore Technology Conference OTC 84147, 2003, Management of Typhoon: A Subsea, Deepwater Development, Ring et. al., p. 3.

[706] Offshore Technology Conference OTC 84147, 2003, Management of Typhoon: A Subsea, Deepwater Development, Ring et. al., p. 1.

Development where "Well 562 #3 exhibited a stuck mechanical safety control valve (SCSSV) located at about 8,000 feet in the wellbore that was remedied with a xylene treatment. Since the well's producing GOR had increased, it was likely the asphaltene onset pressure had increased and that additional asphaltene particles had precipitated."[707]

748. Merrill's concerns fail to recognize the practical realities of Gulf of Mexico deepwater drilling. Merrill disclaims any expertise in whether the presence of tar limits the ability to develop a prospect or whether there are steps to mitigate the presence of tar, noting that these would be more appropriate questions for a reservoir engineer.[708] But to avoid problems associated with asphaltene precipitation or deposits, mitigation plans are always put in place.[709] These can be as simple as designing a development plan and production system that keeps the oil above its AOP (by limiting drawdown or ensuring pressure support is maintained via the aquifer or through water injection) and/or by installing downhole chemical injection systems. As discussed above in my rebuttal to Pittinger ¶ 11(g), multiple mitigation/remediation techniques to deal with asphaltene at Shenandoah were discussed, and these might include preemptive xylene soaks, coiled tubing cleanouts, acid soaks, and production logging.[710] Asphaltene dropout was a production assurance issue that Anadarko was familiar with and was not perceived as an unmanageable issue.

749. **Merrill ¶ 91:** "The combination of fault compartments and lower hydrocarbon recovery seriously impacts ultimate hydrocarbon recovery. The lower hydrocarbon recovery is

---

[707] Offshore Technology Conference OTC 19624, 2008, Lim et al., Design and Initial Results of EOR and Flow Assurance Lab Tests for K2, Frank Lim, Eulalia Munoz, and Brad Browning, pp. 10-11.

[708] Merrill Dep. Tr. 194:6-12.

[709] *See* APC-00044530.

[710] APC-00015676 at 45.

caused because of the dropout of asphaltenes in the reservoir as pressures drop during production. Additionally, faults cut out significant portions of the Wilcox."

750. **Rebuttal to Merrill ¶ 91:** Merrill exaggerates the recovery issues that Shenandoah faced. Although it is true that any fault compartmentalization smaller than ~600 acres might impact field recovery, and it is true that asphaltenes will require mitigation planning which would add some cost to the development project, it is an exaggeration to state that these issues "*seriously* impact[] ultimate hydrocarbon recovery." Mr. Browning saw the relatively "high asphaltene onset pressures" as a "soft limit,"[711] and Anadarko had experience with mitigation strategies and had developed a mitigation plan.[712]

751. Merrill's statement that "faults cut out significant portions of the Wilcox" is also an exaggeration in that the only demonstrated potential example of this is in the area of Shen-4. Post-depositional faulting does not "remove" sedimentary section, it simply divides it; it is not "cut out" as Merrill implies.

752. **Merrill ¶¶ 18(e), 92:** "Tars were also noted in the Shen-4 ST2, a negative fact that Anadarko kept quiet about, even with partners. . . . Tar posed a serious risk to the commercial viability of Shen."

753. **Rebuttal to Merrill ¶¶ 18(e), 92:** Merrill exaggerates the importance of encountering tar. Tar formation in deepwater GOM reservoirs is not unusual and has not deterred

711 APC-00003724.

712 *See* APC-00044530.

major developments.[713] It typically forms near salt, fault zones[714] and paleo-OWCs.[715] The tar is water-washed by the aquifer and can arise from density separation of oil that has settled, or from lighter hydrocarbons that have leaked off. The tar would only be an issue if it is extensive enough to impede either oil flow or water pressure support from the downdip aquifer. However, experience from the WR52-1 well[716] and other similar tar-mats encounters in the GOM referenced by Anadarko,[717] has been that the tar is not laterally extensive,[718] meaning that fluid flow and aquifer support is minimally impacted in spite of some wells encountering it.

754. There is nothing in the record to suggest Anadarko hid the risk of tar from the partners, as all partners had access to the same well data and are technically capable of interpreting it. The one exception, as explained above, was that ConocoPhillips and Marathon Oil did not consent to the Shen-4 ST2 operation,[719] and only the partners that consented to the second sidetrack Shen-4 ST2 were contractually entitled to the data and results from that well.[720] Indeed, when asked if he was aware the reason why Anadarko "kept quiet" was because only some partners consented to the sidetrack, Merrill refused to answer, saying "that was not within the context of

[713] IADC/SPE 111600, 2008, G. Han, et. al. ("Many operators such as ConocoPhilips (Spa Prospect), Chevron (Big Foot), BP (Mad Dog) have reported bitumen encounters.").

[714] APC-01235401 slide #3; *see also*, SPE 125111, 2009, J.C. Cunha, et al. ("Tar occurrence has been associated with the presence of salt and it can be found just under or far below salt. It can also occur within fractures and faults.").

[715] APC-01413136 at 76.

[716] APC-00191621 at 5.

[717] APC-00219133 at 1.

[718] SPE/IADC 105619, 2007, M.H. Weatherl, ("[E]xperience shows that tar in deep water Gulf of Mexico tends to be limited in size, often penetrated in one well but not another a few hundred feet away.").

[719] Marathon_014843; APC-01730272; APC-00216034.

[720] Chandler Dep Tr. 199:20-200:5.

my scientific and technical exploration."[721] I am not aware of Anadarko disclosing tar publicly, but in my experience a detailed technical piece of information like encountering tar in that far up-dip area, which was not viewed as a serious issue for future development planning, would not typically be discussed publicly.

6. Rebuttal to Pittinger's Opinions re: Shen-4:

755. **Pittinger Opinion re: Shen-4:** Pittinger opines that the faulting and tar encountered in Shen-4 rendered Shenandoah non-commercial.

756. **Rebuttal to Pittinger Opinion re: Shen-4:** Pittinger's assessment of Shen-4 places undue emphasis on the results of Shen-4 OH and ignores the positive reaction to the Shen-4 ST1. In doing so, Pittinger overstates the impact of faulting and tar on Shenandoah's viability, as there remained a significant amount of uncertainty as to the extent of the eastern side of the reservoir. Pittinger's theory on commerciality, as explained in previous sections, does not take into account the nature of the appraisal process and the practical reality of working at an oil and gas company. Shenandoah remained potentially commercial, and I am not aware of anyone at Anadarko concluding it was not.

a. *Rebuttal to "The Impact of Faulting: Shen-4 Results"*

757. **Pittinger ¶128:** "Shen-4 results confirmed small-scale faulting and compartmentalization to the point of being described as a 'busted up' reservoir and resulted in a one-third reduction in the field's resource size. The economic impact of Shen-4 was profound, as the estimated resource volume was getting smaller and more complex with each appraisal well and the downside impact of fault compartmentalization had made Shen uncommercial."

[721] Merrill Dep. Tr. 194:25–195:2.

758. **Rebuttal to Pittinger ¶ 128:** Pittinger's opinion relies heavily upon the initial reaction to the Shen-4 original borehole, and fails to account for additional, positive information learned from Shen-4 ST1. When the Shen-4 ST1 results are considered, it is clear that Shenandoah remained potentially commercial; the partnership needed additional information from the Shen-5 and Shen-6 wells to confirm the extent and quality of the reservoir, and was working to devise a development solution appropriate for the reservoir. Pittinger fails to provide evidence that anyone at Anadarko considered these results to condemn the results of Shen-4.

759. **Pittinger ¶ 128(a):** "Considering that most of the Upper Wilcox sands were missing, encountering a wet LWD sand and 14 ft. of wet sands in the LWE was very significant and was not 'full to base.' In my expert opinion, the industry standard usage of 'full to base' would mean that all sands were oil bearing, and 'full to base' does not mean that some sands were oil bearing and others water bearing. It is also inaccurate to state that no water was encountered at Shen-4 ST, or that it was all oil."

760. **Rebuttal to Pittinger ¶ 128(a):** As discussed above in addressing the alleged misstatements, Anadarko accurately described Shen-4 ST1 and Shen-4 ST1 BP as being "full to base." Pittinger does not provide a reference to his petrophysical interpretation of the Shen-4 ST1 and Shen-4 ST1 BP well logs. The final petrophysical interpretation of these zones were that they had high water saturations because of poor quality rock and these zones did not have "free water" in them.[722] When one refers to a well as being "all oil" or as being "full to base," they are implying that no "free water" level (OWC) has been penetrated by the well. The nuances of this assessment might not have been fully appreciated by Pittinger, who is a petroleum engineer and not a

[722] *See* APC-00002305 at slide 11.

geoscientist. His conclusion that Shen-4 well encountered "a wet LWD sand and 14 ft. of wet sands in the LWE . . . and was not 'full to base'" is in error.

761. **Pittinger ¶ 128(c):** "The reservoir quality was not good at Shen-4. Most of the Upper Wilcox sands were missing, and both the LWD and LWE sands were poorly developed and substantially lower in sand quality, as described in the AFE form dated September 31, 2015 and reviewed by Daniels."

762. **Rebuttal to Pittinger ¶ 128(c):** Pittinger's claims that "the reservoir quality was not good" are wrong, as the porosity measured for the LWA, LWB, LWC and LWE sands respectively was 20%, 21%, 21% and 18%,[723] which are comparable to the porosity measured in these sands at the Shen-2 well and are of excellent quality for Deepwater Lower Wilcox sands. The AFE that Pittinger appears to reference is the AFE for the Shen-4 ST Bypass Core. This AFE does not support his statement that the reservoir quality was poor. Rather, that AFE notes that "one of the stated primary goals of the Shen 4 well was to obtain oil filled core in the Wilcox reservoir section that has good representative P&P properties," and "the Lower Wilcox sand section seen in this well appears to meet this criteria."[724]

763. **Pittinger ¶ 128(d):** "Core analysis identified nine different faults in the core alone."

764. **Rebuttal to Pittinger ¶ 128(d):** Pittinger does not provide a reference for this statement, but the Partner Meeting of December 16, 2015 characterized cores 1 and 2 as having "Numerous wide clusters of bands, which is different from the Shen 3 core, indicating enhanced

[723] APC-00001935 at 6.

[724] APC-00001914.

levels of (shear) strain and closer proximity to major faults,"[725] and cores 3 and 4 as being "[r]elatively undeformed compared to cores 1 and 2, (2 main clusters of bands exist), but deformation band based faults do exist in some of the sands."[726] Mr. Chandler testified that he was concerned about the lack of certainty of the orientation of the fault encountered in the Shen-4 ST1 and Bypass wells where the Upper Wilcox was faulted out.[727] Clearly faulting was identified in the cores, but only one major fault was able to be tied to seismic, and the orientation of that fault was unknown.

765. **Pittinger ¶¶ 129, 130:** "The loss of one third of oil in place was a significant blow to the project. McGrievy writes to staff in an email that Shen-4 had encountered the basin margin instead of the intended Wilcox sands. More importantly, the new location of the basin margin reduced the estimated oil in place for the field by one-third as shown below. McGrievy also confirmed that Kleckner would be informed of these developments, making for an interesting discussion with senior management. McGrievy emailed staff on August 28, 2015:

> "'Please keep a tight lid on this but we were hoping to drill the Wilcox section last night and today but found, instead, the basin margin as we are currently drilling salt and will probably TD the well This evening as it appears that we are drilling a salt stock. Preliminary estimates as per some quick updates to the Geomodel by Christian Noll, assuming that we are close to the Wilcox HC sediment interface, is **a loss of almost 1bboe or about 1/3rd of the pre-drill STOIPS (3.2 bboe).** Our estimates now are approximately 2.3 bboe in place. **This outcome may have a profound effect on how we view this project going forward and our update with Jim Kleckner will definitely be an interesting one**.'" (emphasis supplied by Pittinger)

[725] APC-00058398 at 13.

[726] Id. at 17.

[727] Chandler Dep Tr. 193:5-194:19.

"The loss of one-third of the oil in place was significant enough to change the focus of the Shen evaluation to considering slow-down options and exit strategies. In the same email chain, Frye stated the following:

> 'Wednesday Meeting – I think . . . but we can confirm with Pat today that we really just need to talk through different slow down options and the impacts on budget, execution, and 1st oil. Think about and [sic] exit strategy and what that looks like. What we might be prepared to show Bob and Jim.'"

766. **Rebuttal to Pittinger ¶¶ 129, 130:** Importantly, this email exchange was in September 2015, before drilling operations had been completed. At this stage, Anadarko did not have the results of Shen-4 ST1. Regardless, Pittinger's statement that the "loss of one-third oil in place" "change[d] the focus of the Shen evaluation" is misleading. Anadarko had limited "slow down options," such as Ms. Frye suggests, as the leases were under a 180-day continuous operations requirement, meaning the partners either would have had to file a development plan or begin another drilling operation. Ms. Frye also had no authority to pursue an exit strategy, as this would be a decision for management or the Board of Directors, and simply expressed a desire to discuss go-forward options. Also, as detailed below, Ms. Frye's own views on Shenandoah's potential commercial viability appear to have changed following the results of the Shen-4 ST1.

767. **Pittinger ¶ 131:** "The negative impacts of the Shen-4 results were presented to senior management on September 9, 2015 in a file named 'Shenandoah_Kleckner_budget_09-09-2015_v3 (2).pptx' and shown in Exhibit 27 below. The loss of one-third of mapped oil in place was a significant adverse finding, as was a six-month plus delay was a major setback to the Shen project."

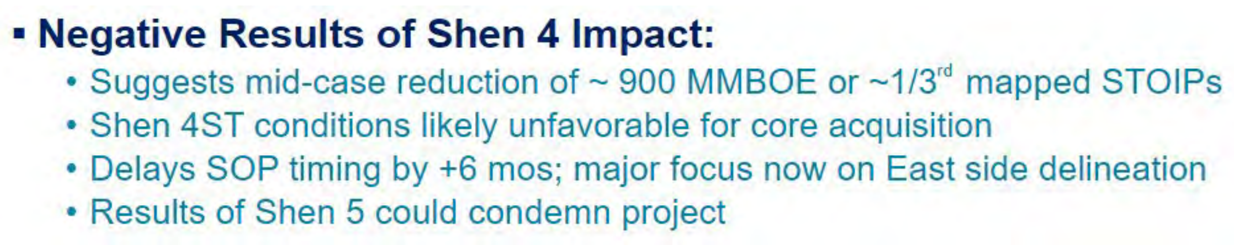


Figure 90 – Pittinger's Exhibit 27: Negative Results of Shen-4 Impact[728]

768. **Rebuttal to Pittinger ¶ 131:** Again, Pittinger neglects to note that the successful Shen-4 ST1 and Shen-4 ST1 BP had yet to deliver their positive results both in terms of deeper LKO and successful cores. In addition, while he concludes that Shen-4 indicated Shenandoah was not commercial, he fails to note that the same slide states that the "major focus [would] now [be] on East side delineation" and that the "[r]esults of Shen 5 could condemn the project," meaning that they still needed those results to determine commerciality.

769. **Pittinger ¶ 132:** "By September 24, 2015, Kleckner was already discussing exit strategy options for an Executive Committee offsite."

770. **Rebuttal to Pittinger ¶ 132:** Possible "exit strategies" are an option that are always considered all along the value chain of exploration-appraisal-development-production, as evidenced by the number of Anadarko field sales in the Gulf of Mexico that had historically been executed. Indeed, Mr. McGrievy testified that as a matter of good practice, "every project . . . should have an . . . exit strategy."[729] Mr. Kleckner testified similarly, noting that Anadarko Leadership would "continually lock at what scenarios were there that we could allocate more resources", and thus would always consider an exit strategy for Shenandoah as part of their

[728] APC-00193551 at 4.

[729] *See* McGrievy Dep. Tr. 286:17-287:4.

portfolio modeling.[730] The fact that there was discussion of an exit strategy for Shenandoah is simply not an indication of the lack of commercial viability of the project.

771. Other testimony supports that exit strategies were commonly considered at Anadarko as good business practice. Mr. McGrievy testified that understanding "optionality" was always a key component of any project,[731] and Mr. Walker provided similar testimony, saying that Anadarko would have modeled an exit strategy because of their dynamic portfolio.[732]

772. The slide that Pittinger cites makes clear that Anadarko had not decided to exit. Indeed, it noted a desire to "FID as quickly as possible," determine the development plan "by year end", bring costs down and develop required technology.[733] All of these indicate that Anadarko treated the Shenandoah project as potentially commercially viable. Recognizing all future options and considering different scenarios is important, particularly if Shen-5 were to be a failure, but "considering" this option is not the same as planning an exit strategy. Every appraisal program has the possibility of not going forward to development (supported by Deepwater statistics) and there needs to always be an option of how to move forward should such a situation occur.

773. **Pittinger ¶ 133:** "Another important finding was the total of high-quality net pay of only 380 ft. compared to the net pay of 1,000 ft. in Shen-2. In addition, the LWC, LWD, and LWE contained 200 ft. of lower quality net pay, which was a significant finding that could impact assumptions of lateral continuity."

774. **Rebuttal to Pittinger ¶ 133:** Again, Pittinger relies on unverified "logging while drilling" numbers from September 2015 that were later revised. Specifically, these numbers were

[730] Kleckner Dep. Tr. 161:5-162:1

[731] McGrievy Dep. Tr. 286:21-287:14.

[732] Walker Dep. Tr. 226:8-17.

[733] APC-00196222.

later revised to 622 feet oil pay in relatively good quality sands as presented in the November Exploration Overview presentation shown in the Figure below. Although the lower Wilcox D sand was earmarked with no recoverable pay, the other sands showed reservoir quality values within the range of the other Shenandoah wells. His conclusion that these values "could impact assumptions of lateral continuity" is unfounded. Most of the oil reservoirs missing in each well are more than likely displaced to the other side of the fault. While the reservoir likely thinned and demonstrated reduced quality, that was because the well was located so close to the edge of the basin. More importantly, the lateral continuity of the turbidite depositional packages consistently matched with those at the Shen-2 well.

CONFIDENTIAL

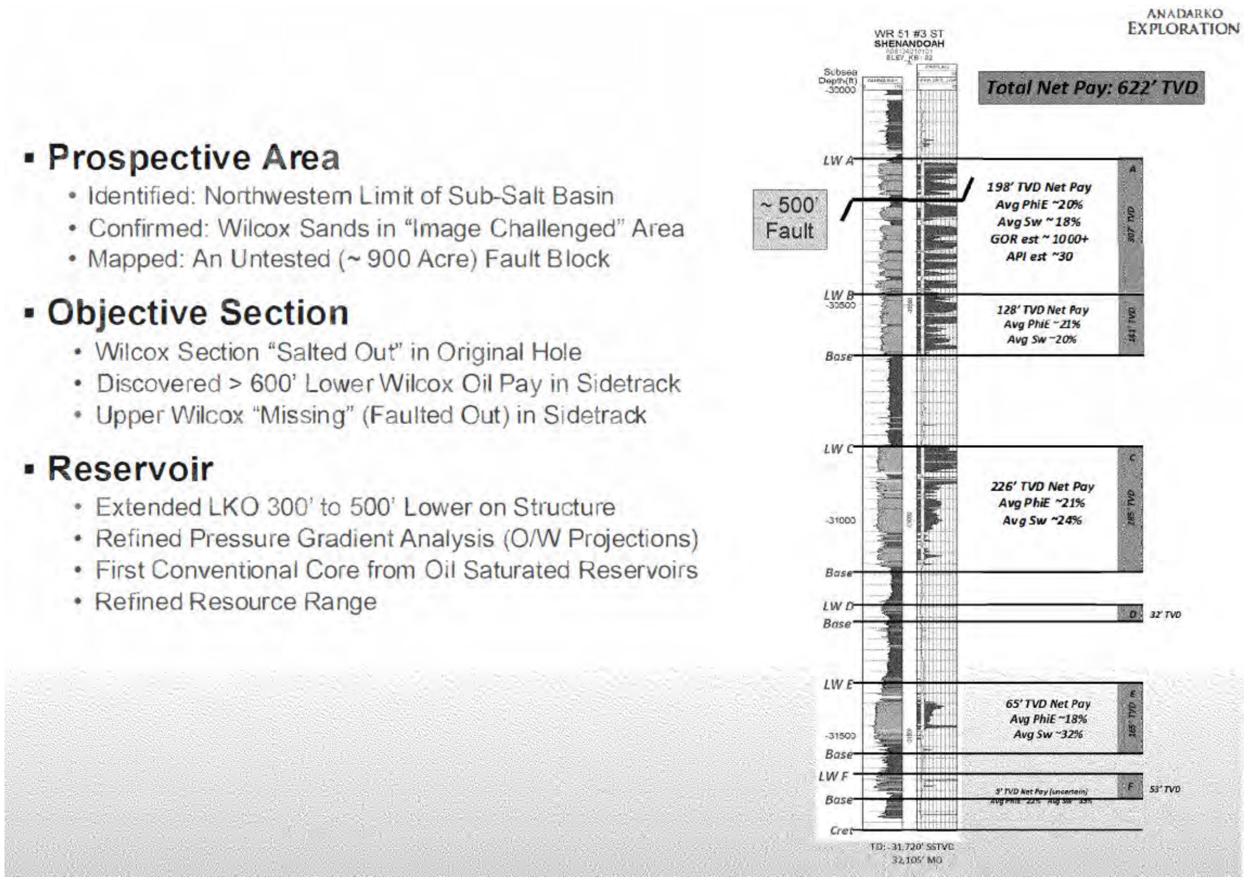


Figure 91 – Exploration Overview presentation from November 3, 2015 outlining the reservoir quality net pay values from Shen-4 ST1.[734]

775. **Pittinger ¶ 134:** "An approved AFE form dated September 30, 2015 and reviewed by Daniels stated that the Shen-ST1 encountered lower quality pay in the LWD and LWE sands, and the Upper Wilcox sands were missing due to faulting. In addition, the LWD was wet and the LWE sand appeared to be wet and/or low porosity."

776. **Rebuttal to Pittinger ¶ 134:** As described in response to Pittinger ¶ 128(c), the Shen-4 ST1 Bypass well AFE was issued in September before petrophysical analysis of the Shen-4 ST1 wireline logs had been completed and includes the preliminary values interpreted from the logging while drilling tools. These numbers were later revised. Pittinger's reliance on preliminary

[734] APC-00001935 at slide 11.

and incorrect values is misleading, and his use of early unverified reservoir descriptions from emails instead of from professional petrophysical analysis is also grossly misleading and incorrect.

777. **Pittinger ¶ 136:** "[T]he wellsite geologist identified slickensides in the bottomhole cuttings that returned to the surface. A slickenside is a rock with a polished surface formed by movement along two sides of a fault, normally showing striations. This observation added yet another source of evidence for faulting within the reservoir."

778. **Rebuttal to Pittinger ¶ 136:** As explained above in assessing Merrill's results, Pittinger overstates the evidence. While Pittinger says that these indicate faulting, that is not necessarily so. Mr. Chandler testified that slickensides are indicative of movement along the two surfaces, which can also be caused by a fracture.[735]

779. **Pittinger ¶ 137:** "The evidence for extensive faulting [at Shen-4] was substantial, as listed in Exhibit 29 from a Shen-4 update meeting presentation. With evidence from multiple sources, ranging from wireline surveys, paleo data, faults in cores, Upper Wilcox sands missing in Shen-4 ST1 and ST1BP, and pressure separation between Shen-4 ST1 and Shen-2, this appraisal well proved the existence of a complex network of faulting, as summarized in Exhibit 29."

780. **Rebuttal to Pittinger ¶ 137:** The faults and small-scale deformation identified at Shen-4 ST1 and Shen-4 ST1 BP were strong indications that Shen-4 ST1 and Bypass encountered a fault. Given the extreme up-dip location of these wells and their proximity to the salt penetrated in Shen-4 OH, one cannot reliably extrapolate these results to all wells across the basin. Pittinger has suggested that this faulting at Shen-4 somehow was evidence of compartmentalization of the Upper Wilcox across the Shenandoah field, which would be a significant and inappropriate exaggeration.

[735] Chandler. Tr. 188:14-189:3.

781. **Pittinger ¶¶ 138, 139:** "Reacting to the news that the Shen-4 ST1 well was in an isolated compartment based on pressures, Oudin raised the question of what can be done to sanction with confidence when the reservoir is compartmentalized, but the size of the compartments remains unknown. In my expert opinion, this question directly addressed the most serious challenge faced by the team's appraising the Shen field. His question is as follows: . . . 'how do you go forward with project sanction when you know your reservoir is compartmentalized, but you don't know how big your compartments are?' . . . Brad Browning made a similar comment a year and one-half earlier: 'Is the reservoir completely broken up by faulting or noisy data? I wonder if we'll know which is the case until a good number of wells are on production. But certainly, if we get more pressure breaks between appraisal wells, we'll have our answer.'"

782. **Rebuttal to Pittinger ¶¶ 138, 139:** Pittinger's opinion that determining the extent of compartmentalization was "the most serious challenge faced by the team's appraising the Shen field" was not shared by everyone working on Shenandoah. Certainly, there was faulting, which had always been considered. But in every deepwater development, there is an uncertainty about the size and extent of any compartment. Unless a well is flowed, one can never be sure about the extent of the volume connected to a well location, and I am only aware of a single extended production test being completed in ultra-deepwater Gulf of Mexico (Chevron's Jack).[736] This is an uncertainty which one manages to an acceptable level through the use of analogue fields, additional appraisal drilling, seismic reprocessing, and development design that allows one to react positively to a range of likely outcomes.

---

[736] Hart Energy, "Chevron sets test record at Jack appraisal in Gulf of Mexico," Sept. 5, 2006, https://www.hartenergy.com/exclusives/chevron-sets-test-records-jack-appraisal-gulf-mexico-25329.

783. Moreover, as Pittinger recognized, determining the extent of compartmentalization was an uncertainty about the project. Mr. Browning expressed the uncertainty of the extent of faulting, "wonder[ing] if we'll know [if the reservoir is completely broken up by faulting or noisy data] until a good number of wells are on production."[737] Mr. Oudin's email confirms that there continued to be uncertainty that comes with faulting. It was a recognized risk early in the project that everyone knew would need to be managed. Even after Shen-4, significant uncertainty remained. Anadarko would need to continue to appraise the resource and understand the extent of faulting before reaching a final investment decision.

784. **Pittinger ¶¶ 140, 141:** "With Shen-4 ST1 in its own pressure compartment, all Shen wells with oil pay have proved to be pressure isolated from one another. Shen-1BP2, Shen-2, and Shen-4 ST1 have proved to be isolated from one another, providing at least part of the answer to Brad's question of whether the reservoir is completely broken up by faulting. . . . Wilkens identified a total of nine faults in the Shen-4BP1 cores and made the following observations on deformation bands observed in cores 1 and 2:

> 'Most clean sands contain deformation bands
>
> Numerous wide clusters of bands, which is different from the Shen 3 core, indicating enhanced levels of (shear) strain and closer proximity to major faults.'"

785. **Rebuttal to Pittinger ¶¶ 140, 141:** Pittinger's conclusion that this is proof that "whether the reservoir is completely broken up by faulting" is another gross exaggeration based upon the data available. The Shen-4 ST1 well is nearly a mile away from the Shen-2 well, and the Shen-2 well is well over a mile away from the Shen-1 well. Interpreting a fault between each of these wells because of oil pressure differences is hardly evidence that the "reservoir is completely

[737] APC-00004880.

broken up by faulting." What is clear at this point is that there are hydrocarbon compartments of undetermined sizes.

786. **Pittinger ¶ 142:** "Foldbelt Asset Team Update labeled 'Abendshein Update' and dated December 2, 2015 provided the following assessment of whether overall Shen-4 results were favorable or disappointing as follows: '***Sanction pushed bqack [sic] 5 months as result of disappointing appraisal efforts on Shen 4, Shen 4ST.***' The delay of a multibillion dollar project by five months is a significant and negative development." (emphasis supplied by Pittinger)

787. **Rebuttal to Pittinger ¶ 142:** While the delay was a negative development, Pittinger selectively quotes from the update. The update also notes the progress on the project, including completing the geo-modeling framework, noting that the partners were "[w]ell aligned on strategy and recommendation on moving 4 discrete geologic models into dynamic reservoir simulation phase" and "[a]ll partners endorsed geo-modeling strategy and approach," the outcome of which would be "extremely important in maintain partner alignment on STOOIP size, recoveries and economics;" that a "Reservoir Commingling meeting" was scheduled with BOEM-BSEE to "understand flexibility of completion strategy;" that the partnership had approved of IPT funding and 20A funding; that the seismic was being reprocessed; and that the partners had agreed to move forward with a wet development solution.[738] In other words, while the results of Shen-4 were noted as "disappointing" and sanction was pushed back, there continued to be forward progress. Notably, even the portion quoted by Pittinger affirms that the project was still moving toward sanction, albeit on a later timeline.

788. **Pittinger ¶ 143:** "Another downside of the well was that Shen-4 ST1 encountered lower quality sands in the LWC, LWD and LWE as discussed above. The impact was significant

[738] APC-01350202.

enough that Frye, Shotts, and Prosser collaborated on a sensitivity case in which some or all zones were excluded from development in the reservoir simulation scenario. Prosser is quoted below addressing how zone exclusion might vary across the field. 'I like all the information Doug has incorporated. The only scenario I would maybe like to see is No LW-C-D-E. This is probably a later sensitivity because it may just be a waste of time depending on Shen 5 results, but it would be interesting to see No LW-C-D-E on the Western portion of the field, and from Shen 2 to the east maybe just leave out LW-D-E. What do you think?'"[739]

789. **Rebuttal to Pittinger ¶ 143:** Pittinger again uses early, not-yet-updated values as the basis for his arguments about sand quality at Shen-4 ST1. Pittinger's conclusions that the "Shen-4 ST1 encountered lower quality sands in the LWC, LWD and LWE" are based upon the references discussed above, all of which were demonstrated to be from exchanges that were unverified and later revised. The reservoir quality numbers (porosity) numbers for Shen-4 ST1 were later revised to 622 feet oil pay in relatively good quality sands as presented in the November Exploration Overview presentation previously show above. Although the lower Wilcox D sand was earmarked with no recoverable pay, the other sands showed reservoir quality values within the range of the other Shenandoah wells.[740] Pittinger's continued use of these early unverified "logging while drilling" values is misleading and not correct.

790. In addition, Pittinger's quote from Mr. Prosser[741] stating that "Prosser is quoted below addressing how zone exclusion might vary across the field" simply expresses Mr. Prosser's interest in a modeling study to examine the impact of excluding certain zones from different areas

[739] Expert Report of Lyndon Pittinger, ¶ 143.

[740] APC-00001935 at slide 6.

[741] Expert Report of Lyndon Pittinger, ¶ 143.

of the field. Mr. Prosser gives his opinion about what types of models Mr. Shotts might test. This represents a recognition of a potential risk—not a confirmation that this had actually occurred.

791. **Pittinger ¶ 144:** "The sensitivity runs completed by Shotts evaluated the loss of resource by excluding deeper, marginal zones and are summarized in Exhibit 30 below. Leaving out one or two of these lower-quality sands had a relatively small impact on recovery. For example, leaving out the LWC sand resulted in a loss of only 1.2% of oil in place. With the UW 1-3 zones missing in the Shen-4BP1 bypass well, that leaves only the LWA and LWB as attractive target zones in this part of the field. The author did not find any documents establishing that these results were discussed with management, but the slides were included in a file for a partner meeting. The exclusion of oil-bearing zones was not assumed in any of the resource estimates apart from this study."

792. **Rebuttal to Pittinger ¶ 144:** Mr. Shotts conducted a sensitivity test to understand which reservoir sands contain the best value in the field. Pittinger references the presentation where these results are presented, which occurs at a March 2016 Subsurface Meeting and is shown in the below Figure.

CONFIDENTIAL

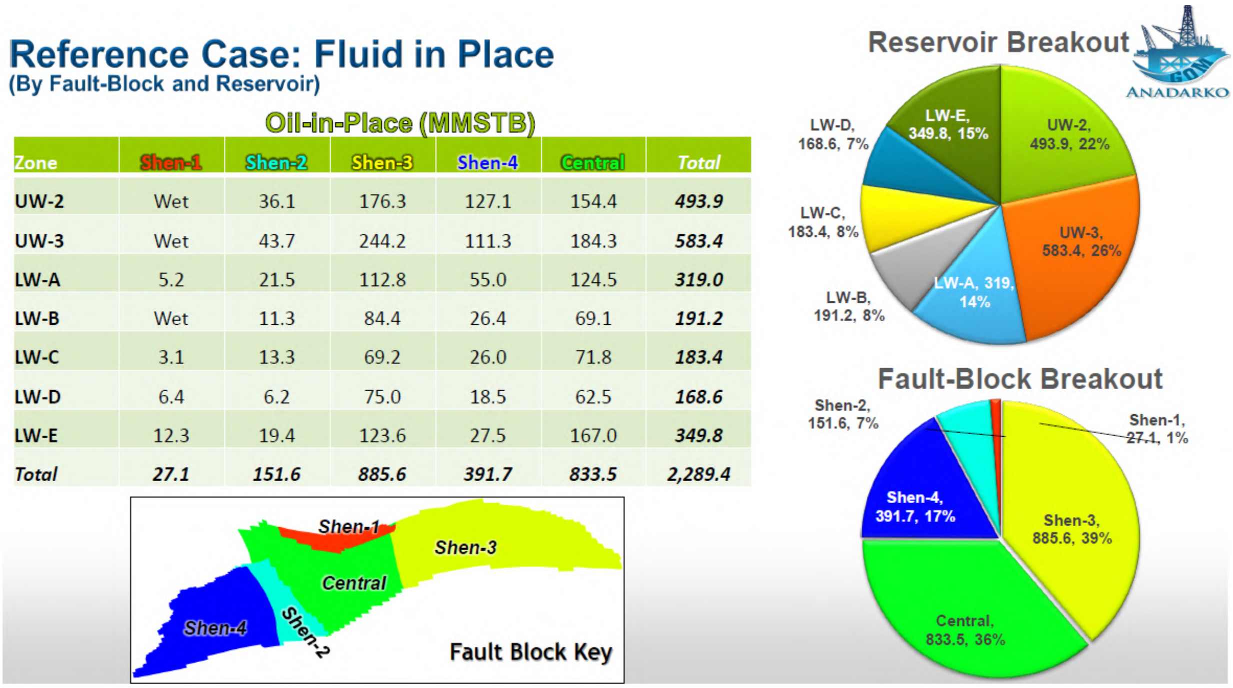


Figure 92 – Reference Case for Fluid-in-Place by Fault Block and by Reservoir calculated by Mr. Shotts and Ms. Frye shown in March 2016 Partner Subsurface Meeting.[742]

793. These plots include the corrected updated values for reservoir quality, account for remaining above Asphaltene Dropout Pressures, and include a phased development. Contrary to Pittinger's conclusion, significant resources are contained in each of the reservoir levels. And while Pittinger complains that zones were not excluded from resource estimates, as he recognizes, this was only a study. He does not give any basis for including these sensitivities in Anadarko's working numbers.

794. **Pittinger ¶ 145:** "A partner meeting on December 16, 2015 showed a slide in Exhibit 31 that provides a valuable summary of the impact of Shen-4, Shen-4 ST1, and Shen-4 ST1 BP. As stated earlier, the original Shen-4 well encountered salt and the basin margin, reducing the estimated oil by one-third. Substantial differences over such a short distance between Shen-4

[742] APC-00233134 at slide 16.

ST1 and the bypass core revealed a high degree of fault complexity on the western flank, warning of potential structural complexity in the eastern half of the field."

795. **Rebuttal to Pittinger ¶ 145:** Pittinger wrongly extrapolates the results at Shen-4 to the eastern part of the field. The reference Pittinger uses makes no mention of any impact on the eastern half of the field and only notes "additional structural complexity on West Flank."[743] Pittinger's extrapolation of Shen-4 structural results to a different structural setting located over three miles away to the east is inappropriate and not supported by any evidence.

796. **Pittinger ¶ 146:** "A comparison of Exploration structure maps pre-and post-Shen-4 in Exhibits 32 and 33 is quite illustrative of the complexity added to the western half from Shen-4 but not yet taken into account in the eastern half of the field. Before Shen-4, the Exploration map included a single north-south fault crossing the oil accumulation, shown as the grey linear feature. After the Shen-4, Shen-4 ST1, and Shen-4 ST1 BP wellbores were drilled, the map required three faults within a mile of each other to accommodate the anomalous findings, along with a substantial contraction of the northwestern edge of the reservoir. The eastern half of the oil accumulation on the Exploration map remained unfaulted. In my expert opinion, given the amount of evidence on complex faulting added by Shen-4, an assumption of no faulting in the eastern half of the structure appears unreasonably optimistic."

797. **Rebuttal to Pittinger ¶ 146:** Pittinger continues to draw unsubstantiated conclusions about the eastern portion of the Shenandoah trap; Pittinger has no basis for making this claim. He offers this as his "expert opinion," but Pittinger is not a geoscientist and has little experience in deepwater subsalt turbidite depositional systems. He makes no references or citations supporting his claim. The faulting added to the Shen-4 area was based upon evidence and was not

743 APC-01160608 at 5.

surprising given how close to the salt the Shen-4 ST1 and Bypass were. The seismic imaging in the areas of Shen-4 was very poor. None of these criteria apply to the area around Shen-3. Although there may be remaining uncertainty in the areas up-dip of Shen-3 in the east, the structural complexity that defined the Shen-4 area would not be expected and is not supported by either the Shen-3 well or by the seismic imaging in that area. In my expert opinion, Pittinger is wrong in making this extrapolated conclusion. Plaintiffs' other expert, Merrill, recognized that he could not say, based on the results of Shen-4, what "other faults" in the field looked like, as "[t]here were no wells through those faults."[744] This confirmed Anadarko Exploration's strategy of only putting faults on their maps that were confidently demonstrated.

798. **Pittinger ¶ 147:** "McGrievy identifies in a later email his main concerns with the differences in resource assessment between the Development and Exploration teams. By assuming no fault barriers to the east and OWCs extrapolated from Shen-3 pressures, Exploration's P90 oil in place estimate at the time was five times larger than the Development Team's P90 estimate. Such a large difference between two technical teams supposedly working together and accessing the same data does not seem plausible and a red flag for senior management. However, given Leyendecker's long record of opposition to the consideration of faulting, management interference may be a more likely explanation for the significant difference."

799. **Rebuttal to Pittinger ¶ 147:** Pittinger's claim about Anadarko's teams' cooperation is unsubstantiated. The email that Pittinger references is Mr. McGrievy's response to the Development team's preparation for Anadarko's RCT review in January 2016.[745] One of the purposes of the RCT review is to reach a consensus between the Development and Exploration

[744] Merrill Dep. Tr. 61:21-62:6.

[745] APC-00059603.

teams on the risk associated with the eastern portion of the field. However, Pittinger's remark that "given Leyendecker's long record of opposition to the consideration of faulting, management interference may be a more likely explanation for the significant difference" is accusatory, speculative and not supported by the record. In fact, Mr. McGrievy clearly defines the explanation for the difference in Development and Exploration P90 volume estimates in his email – "By virtue of their portfolio model, Exploration continues to maintain that the east side is essentially risk free and that their P90 represents a limit identified by the MDT data and an extrapolated OWC from the Shen 3."[746] Mr. McGrievy differentiates the Development position as "the P90 should be defined by a non-sealing fault which allows the east side to be open to the Shen 1."[747] In fact, Exploration's position is based upon the *opposite* reason that Pittinger argues that Mr. Leyendecker is opposed to—Exploration is relying on there being a fault/weld separating Shen-1 from Shen-3.

800. **Pittinger ¶ 148:** "The Risk Consistency Team (RCT) facilitated a meeting on January 11, 2016 between the Exploration and Development teams to resolve their differences . . . An insightful comment regarding faulting is as follows:

> 'Chip Oudin: The Shen-4 series of wells has been eye-opening and extremely valuable in terms of defining basin edge and in terms of the complexities that are going on with the sands. Now we need to understand the east side of the field.'"

801. **Rebuttal to Pittinger ¶ 148:** Pittinger references the Meeting Notes from the January 11, 2016 RCT Meeting at Anadarko. Mr. Oudin's comment is "regarding faulting", and his statement makes it clear that he recognizes the unique setting of the Shen-4 wells near salt with respect to faulting. His comment that they "need to understand the east side of the field" is targeted

[746] APC-00059603.

[747] APC-00059603.

specifically at understanding whether any up-dip fault complexity might exist in that area.[748] Mr. Oudin's comment specifically demonstrates that at this stage, Anadarko lacked sufficient information about the east side of the field. This remained a significant uncertainty that would have an important bearing on the commerciality of the field.

802. **Pittinger ¶ 150:** "Camden agrees that a pressure shift exists between the two wellbores and that they were drilled in a faulted area, which is important because it indicates that fault compartmentalization occurs over short distances. He also stated that the Shen-3 aquifer was not connected to the western side of the field.

> 'Yes, there is a pressure shift between the S/T and the By-pass core wellbores – which would indicate some sort of compartmentalization. We believe the area where we placed the Shen #4 wellbore(s) to be fairly complex and faulted up a bit. Also, I also am using the Yuc#2 aquifer pressures to estimate OWCs. I don't think the Shen #3 aquifer is connected to the western side of the field.'"

803. **Rebuttal to Pittinger ¶ 150:** Pittinger misrepresents the implications of faulting. The full exchange between these two include the following query from Ms. Peng – "Given the bottom hole distance of the two is only about 400 ft, do you think the difference is caused by a pressure barrier or just by some possible measurement errors? As for the calculation of OWC, I have been struggling to select the most representative well for the water pressure. Currently I am using Yucatan 2 (WR96-1 BP1) water pressure for the OWC calculation of western fault blocks and Shen 3 for the central and eastern fault blocks. What is your opinion?"[749]

804. Pittinger's conclusion that this pressure shift between the two boreholes "indicates that fault compartmentalization occurs over short distances" is not exactly true; the pressure shift simply implies that the fault occurs between the two wells and has nothing to say about the size of

---

[748] APC-01702198.

[749] APC-00060671.

either compartment on either side of the fault. In addition, Pittinger's statement that Mr. Camden "stated that the Shen-3 aquifer was not connected to the western side of the field" is false. Clearly from the exchange referenced above, Ms. Peng is not sure whether to use Shen-3 pressures for this far west side of the field, or to use the more proximal Yucatan-2 pressures. Mr. Camden does not say that "the Shen-3 aquifer was not connected to the western side of the field"; he states that he "think[s]" it might not be, so he is using Yucatan-2 pressures.

805. **Pittinger ¶ 151:** "A petrophysical analysis comparing Shen-4 ST1 to ST1BP in Exhibit 35 shows substantial differences in wellbores located only 400 ft. apart based on a post-Shen-4 presentation with partners. . . . Net oil pay was 626 ft. in ST1 but only 473 ft. in the nearby bypass core, 24% less. In other words, moving 400 ft. laterally from the ST1 to the BP core resulted in the loss of 153 ft. oil pay. Part of the UW2 sand was present in ST1 but missing in ST1BP. The LWD was wet in both wellbores, but the LWE and LWF sands were faulted or pinched out in the ST1BP wellbore. The source rock for the LWE sands also changed in the short distance from the ST1 and BP1 wellbores."

806. **Rebuttal to Pittinger ¶ 151:** Pittinger neglects to point out that this presentation confirms that Shen-4 ST1 and Bypass "[r]eservoir quality [is] consistent with other Shenandoah wells."[750] He also provides no support of his statement that "[t]he source rock for the LWE sands also changed." In fact, the "source rock" has nothing to do with the LWE sands and is quite a bit deeper and older than the Lower Tertiary aged section. Any oil fluid differences in each Wilcox reservoir are due to the migration and fill history of each reservoir and not due to the identity of the source rock. With respect to the LWE sand thickness and character being different between Shen-4 ST1 and Shen-4 ST1 BP, at the edges of a syndepositional basin, rapid changes in the sands

[750] APC-01351563 at slide 6.

would be expected. As the basin filled, the earliest sands filled the deepest accommodation space in the center of the basin first, creating thinner onlaps at the basin's edge. Again, this a function of being so close to the basin's edge near the salt-sediment interface.

807. **Pittinger ¶ 152:** "In my expert opinion, complex faulting was the most probable cause for such stark differences over such a short distance. The pressure isolation between Shen-2, Shen-4 ST1 and Shen-4 ST1 BP1 added additional weight to the argument for extraordinary fault complexity in the Shen reservoir. Given the weight of this evidence, in my expert opinion, it is improbable that aquifer pressures in Shen-3 and Yucatan-2 had any relevance in determining OWCs in isolated fault blocks."

808. **Rebuttal to Pittinger ¶ 152:** Pittinger expresses his expert opinion that, based upon the Shen-4 results, measured water well pressures in the basin are not representative of water pressures downdip of any OWC in the basin. Pittinger is correct in concluding that "complex faulting was the most probable cause for such stark differences" between the Shen-4 ST1 and Shen-4 ST1 BP wells. However, his argument that there is "extraordinary fault complexity in the Shen reservoir" is only applicable to the structurally complex areas up-dip and near salt. The other areas of the basin and the other appraisal wells have not demonstrated that same level of complexity, even with their sidetracks and bypass wells. Pittinger's expert opinion that "it is improbable that aquifer pressures in Shen-3 and Yucatan-2 had any relevance in determining OWCs in isolated fault blocks" is in conflict with many other experts at Anadarko, ConocoPhillips, Venari, Marathon, and Cobalt. None of the fault blocks drilled or mapped by any Shenandoah team thus far demonstrate a disconnection between any oil accumulation from its common downdip aquifer or that the basin aquifer is not in pressure equilibrium. In my expert opinion, these teams are applying "best practices" for estimating the likely locations of unknown OWC.

b. *Rebuttal to "Appraising the Shenandoah Resource: Shen-4"*

809. **Pittinger ¶ 236:** "The results from drilling the Shen-4 well were disappointing" and "provided substantial evidence Shen was no longer commercially viable."

810. **Rebuttal to Pittinger ¶ 236:** Pittinger's opinion that after Shen-4 was drilled that the field was commercially unviable is not supported by the record and has several weaknesses.

811. As an initial matter, Shen-4 ST1 found 626 feet of oil in good quality, correlatable sands. In fact, following the Shen-4 ST1 results, Ms. Frye emailed members of the Exploration and Development team, congratulating them on the success of the well writing, "This is exactly the results this project needed to keep things going."[751] The well and its sidetracks helped delineate the size of the resources on the western flank, provided important information on the structural complexity one might face near the salt-sediment interface, and provided the first critical oil-saturated core from which accurate measurement could be made. In defining the objective of appraisal as collecting valuable data that can drive decisions, Shen-4/Shen-4 ST1/Shen-ST1BP delivered. Both Anadarko Exploration and Development, and the majority of the Shenandoah partners continued to view the project as economically viable and worthy of continued appraisal investment. Members of Anadarko's Development team, including Lea Frye[752] and Pat McGrievy,[753] testified that Shenandoah could still be economic after Shen-4.

812. More importantly, Pittinger misrepresents the relevance of a PIR measurement as is used in the oil and gas exploration business. Pittinger makes a number of references to a "PIR10" being a threshold for economic viability,[754] and that based upon this criterion, following Shen-4

[751] APC-00646864.

[752] Frye Dep. Tr. 102:14-19, 206:17-207:9.

[753] McGrievy Dep. Tr. 236:16-237:25.

[754] Expert Report of Lyndon Pittinger, ¶ 13(c)-(e), (l)-(n).

the project was demonstrated to be "uneconomic." However, the PIR10 calculations that Pittinger quotes are based upon using the P50/Means of a large range of uncertain parameters and costs with a number of unvalidated assumptions. The PIR10 for the P10 (largest) case would be significantly more positive, and during appraisal is still within the range of outcomes. The PIRs are calculated during appraisal to identify areas of uncertainty that have the greatest impact on the development planning so that the most important uncertainties can be addressed during the appraisal. Only when these uncertainties are small enough that a decision can be confidently made whether to move forward with development can appraisal be considered complete. It is only the PIR10 that is calculated at the end of appraisal that determines if a project is "economically viable."

813. Additionally, Pittinger's conclusion that Shenandoah was not commercially viable is inconsistent with the determinations of Anadarko Exploration and Development, and the Shenandoah partners who were independently still assessing Shenandoah as being commercial and who supported continued spending for a Shen-5 and Shen-6 appraisal. Mr. McGrievy testified during his deposition that when the Shen-5 AFE was submitted, Development viewed Shenandoah as commercial,[755] and Ms. Frye testified similarly during her deposition.[756] Ms. Frye also testified that the commercial viability of Shenandoah depended heavily on the results of Shen-5 and Shen-6.[757] Pittinger fails to address this point in his report, and when questioned on this topic in his deposition, he testified that it was "outside the scope of his report."[758] Additionally, Pittinger's opinion on this topic is inconsistent with Plaintiffs' other technical expert, Merrill, who testified

[755] McGrievy Dep. Tr. 285:14-16.

[756] Frye Dep. Tr. 102:14-19.

[757] Frye Dep. Tr. 206:17-207-9.

[758] Pittinger Dep. Tr. 257:21-259:5

that whether or not Shenandoah was a commercially viable field "was unknown at any time during the class period."[759]

814. Finally, while Pittinger contends that Anadarko's economics did not fully incorporate the downside risks, Pittinger does not conduct his own economic calculations regarding what he considers appropriate incorporation of the downside risks. As explained throughout my report, the evidence shows that Anadarko was in fact considering these risks and did not conclude that any of them made Anadarko non-commercial.

c. *Rebuttal to "Appraising the Shenandoah Resource: Post Shen-4 ST1: Exploration Team"*

815. **Pittinger ¶¶ 240–244:** "When adjusted for depth, Shen-4 ST1 pressures in the oil column were higher than those measured in Shen-2. The Exploration team assumed that the higher oil pressures overlaid the same aquifer pressure gradient measured in Shen-3, despite being separated from Shen-4 by a distance of over three miles and numerous recognized faults, resulting in a deeper projected OWC, especially in the LWC and LWE horizons. In my expert opinion, evidence for faulting was too abundant to continue with the hope that Shen-3 and Shen-4 ST1 were in pressure communication to project the OWCs. Shen-4 ST1 did not even communicate with Shen-4BP1, which was only 300-400 ft. away. . . . Based on my expert opinion, it was highly unlikely that Shen-3 and Shen-4 ST1 were in pressure communication through an aquifer given the more than 15,000 ft. lateral distance between the wells, unexplained water sands in the LWE sand of Shen-4 ST1, several intervening mapped faults, observed pressure compartmentalization, and extensive evidence for faulting."

[759] Merrill Dep. Tr. 63:10-64:5.

816. **Rebuttal to Pittinger ¶¶ 240–244:** Pittinger does not agree with using Shen-3 water pressures to project an estimated OWC at Shen-4 ST1. However, this projection provided the "best estimate" of where the OWC was likely to be located, as no other method would provide a better technical estimate. In addition, despite the large distance between Shen-3 and Shen-4 ST1 wells, the basin aquifer is likely to be at a "close-to-common" pressure given the tens of millions of years it has had to equilibrate. The Shen-3 (or Yucatan-2) water pressures are likely to project the best estimate of an OWC at Shen-4 ST1. Pittinger also comments that "Shen-4 ST1 did not even communicate with Shen-4 BP1, which was only 300-400 ft. away" as evidence against using water pressures, but this is a completely different situation where the question is one of up-dip oil communication across a north-south fault and not a question of communication to downdip water.

817. **Pittinger ¶ 245:** "Unfortunately, no MDT pressures were obtained in the wet LWD horizon of Shen-4 ST1. Such pressure in the LWD water-bearing zone would have settled the issue of whether or not the water-leg pressures in Shen-4 ST1 were in communication with Shen-3."

818. **Rebuttal to Pittinger ¶ 245:** Pittinger admits the uncertainty associated with the Shen-4 ST1 lower Wilcox "D" sand. Such a measurement would have also addressed the issue as to whether any of the sand was below the OWC or truly "wet" at all.

819. **Pittinger ¶ 246:** "*If* the LWD pressures in Shen-4 ST1 fall between the LWC and LWE horizons gradients, the LWD water gradient would be 200-300 psi greater than the water gradient in Shen-3, proving isolation with Shen-3. In my expert opinion, it is *improbable* that the pressure gradient in the LWD sands of Shen-4 ST1 would shift to the left of the LWC and LWE trends by 200-300 psi to follow the same gradient of Shen-3, making it highly *unlikely* that Shen-3 and Shen-4 ST1 are in pressure communication through a shared aquifer." (emphasis added)

820. **Rebuttal to Pittinger ¶ 246:** Pittinger's argument is speculative. Pittinger arrives at a very weak conclusion since it only applies to the LWD formation and is based upon a supposition that "if" the LWD gradient was water, and "if" it fell below other ST1 gradients, then his conclusion might follow. Even if Pittinger's argument was partially verified with additional data, it would not change the fact that a projection of an estimated OWC using basin water pressures is still the best estimate available.

821. **Pittinger ¶ 247:** "The areas for the eastern fault were based on the same assumptions as the November 2014 MMRA evaluation. The lower end of the downside outcomes was vastly overstated by their P90 estimates, despite the findings from Shen-4 that highlighted the critical impact that complex faulting was having on the Shen discovery. Instead, the Exploration team's model for the areal extent in the eastern block remained unchanged. The P90 area for the eastern blocks continued to show no downside risk of faults limiting the eastward and northern extent of oil and minimal risk of shallower OWCs."

822. **Rebuttal to Pittinger ¶ 247:** Pittinger suggests that "the findings from Shen-4 that highlighted the critical impact that complex faulting" which were made very close to the salt wall in the west and should now be applied to a much better imaged area in the east. Again, these areas are in very different structural settings and are many miles apart from each other. Suggesting that they are analogous areas is not supported by any interpretations or evidence. Neither Anadarko's Development team nor their partners made structural changes to the eastern areas after the Shen-4 appraisal. It is not valid to criticize Exploration for not adding more faults to the east based on Shen-4 results in the west. Since no seismic could position any additional faults to the east and no new data indicated where they would be located, none were put on the Exploration maps and, similarly, changes in the east were not made on Development maps.

823. **Pittinger ¶ 248:** "The estimates for net pay assumed in the November 2015 MMRA evaluation remained unchanged from the November 2014 MMRA work, despite evidence from Shen-4 ST1 that net pay in the well was 625 ft. TVT, providing further support for formation thinning higher on the structure. Simply taking the average of the three oil wells drilled up to this time yields an average of 621 ft, which is 47% less than the Exploration team's assumed mean of 1,168 ft. The P90 assumed net pay value of 1,010 ft. was similar to the best oil result encountered to this date, and the P10 value exceeded the best oil result by 34%. In my expert opinion, the estimate for the mean net pay of 1,168 ft. was extraordinarily optimistic and failed to recognize the results from analog wells and evidence for crestal thinning. Exhibit 62 compares assumed net thicknesses relative to the actual results from three wells."

824. **Rebuttal to Pittinger ¶ 248:** Pittinger's claim that "evidence from Shen-4 ST1 that net pay in the well was 625 ft. TVT, providing further support for formation thinning higher on the structure" is erroneous. The reduced net pay at the Shen-4 ST1 and Shen-4 ST1 BP was due to the upper section being faulted out, not because of any additional depositional thinning beyond which was already accounted for in Exploration's isopach maps (shown earlier). When part of a geologic section is "faulted out" in a well, it has not somehow disappeared; it has simply been displaced and is still valid a part of the isopach. Other than a structural update and some change in OWCs in the west, the action Exploration took to remove the Shen-4 OH "salt" area from their map is the only appropriate update necessary for changing STOOIPs as a result of the Shen-4 wells. This is why Exploration's net pay values remained unchanged. Pittinger's suggestion of "taking the average of the three oil wells [that were] drilled up to this time [to] yields an average" as a way to estimate net pay is a very poor methodology and misaligned with his earlier opinions regarding best practices for doing calculations using MMRA.

825. Pittinger's conclusion that "the estimate for the mean net pay of 1,168 ft. was extraordinarily optimistic and failed to recognize the results from analog wells and evidence for crestal thinning" is wrong. The isopachs that Exploration used at each step all demonstrated "crestal thinning."[760] The Exploration team properly accounted for all of the Shenandoah wells and used isopach maps to derive their net sand values. Pittinger cites no maps nor presents any evidence for this conclusion that Exploration failed to account for "crestal thinning", and there are no Exploration maps showing thicker sands up-dip, as he claims.

826. **Pittinger ¶¶ 249, 250:** "Earlier in December 2015, Strickling emailed a presentation representing Exploration's view of Shen economics. At the same oil price of $60/bbl as Development's analysis, Exploration's estimate of net present value discounted at 10% (NPV10) was shown as $1,526 MM in Exhibit 63. This result was extraordinarily higher than Development's NPV10 of -$185 MM, partly because Exploration's resource volume was inaccurately based on the post Shen-3 assessment instead of post Shen-4 update. . . . In my expert opinion, Exploration should not have submitted such obsolete and optimistic evaluation results after Shen-4 provided substantial negative findings."

827. **Rebuttal to Pittinger ¶¶ 249, 250:** Pittinger's claim that "Exploration's resource volume was inaccurately based on the post Shen-3 assessment instead of post Shen-4 update" is misleading and unreasonable. This was a December 2015 document, and Shen-4 core operations did not complete until late November 2015. Pittinger cites no evidence that Exploration had finished assessing well results and had updated their economic modeling by December 2015 and ignores evidence suggesting that Exploration had not fully incorporated Shen-4 results into their

[760] APC-00633951 at slides 1-2; APC-00016754 at slides 80, 83.

economics until mid-January 2016.[761] Moreover, Pittinger fails to note that the following month, the Development team, not the Exploration team, presented the Shenandoah economics to the Executive Committee.

d. *Rebuttal to "Appraising the Shenandoah Resource: Post Shen-4 ST1: Development"*

828. **Pittinger ¶¶ 251–254:** "On December 4, 2015, the Development team revised their resource assessment downward from a mean of 397 MMBOE to 304 MMBOE, a 23% reduction in the mean. Exhibit 64 compares key input assumptions and results from Exploration's and Development's post-Shen- 4ST1 resource assessment. Development's only significant change in input assumptions was that the P90 area was reduced by half from 1,600 acres to 800 acres, reflecting the highly negative result of encountering salt on the original hole and evidence for compartmentalization and crestal thinning from Shen-4 ST1." Pittinger then describes emails between the Development team discussing Exploration's numbers.

[761] APC-00059603 at -603 (noting on January 10, 2016 that "[E]xploration still carries pre-Shen 4 volumes, but they anticipate reducing each of their cases by about 20% once they have integrated the results.").

CONFIDENTIAL

		Post Shen-4ST1	
		Development	Exploration
Block Areas		Combined	Combined*
Risk		100%	100%
Area, Acres	P90	800	1,723
	P10	3,000	2,680
Net Pay, ft	P90	500	1,010
	P10	1,000	1,339
Recovery Factor	P90	13.8%	20%
	P10	30.8%	30-35%
Resource, MMBOE	P90	100	635
	Mean	304	755
	P10	607	883
** sum of P90 and P10 values*			

Exhibit 64: Comparison of Assumptions, Development to Exploration

Figure 93 – Pittinger's Table comparing post-Shen-4 ST1 Volume Assessment inputs between Anadarko Exploration and Development teams.[762]

829. **Rebuttal to Pittinger ¶¶ 251–254:** The principal difference between Exploration's and Development's volume assessments, both before and after Shen-4 ST1, was in their estimations of the P90 values in area (800 vs. 1723), in net pay (500 vs. 1010), and in recovery factor (13.8% vs. 20%). The differences in areas are dominantly driven by their different interpretational assessment of the eastern area. The net pay differences are driven by different views of methodologies by Exploration, who used isopachs tied to wells, and Development, who used measured well ranges. The recovery factor differences are driven by Development's different view of the risk of compartmentalization and lack of potential aquifer support. Each of these views remained unchanged from before Shen-4 ST1 to after the well, with the exception of removing the area that Shen-4 OH proved to be non-reservoir, which each team did.

[762] Id. Exhibit 64 p. 106.

830. Each team's interpretation style, strengths, weaknesses, and biases are contained within their interpretive estimates. There is no "correct" or "incorrect" interpretations if they honor the "hard" data, but some practices from each team are likely to be better than the others' – *e.g.*, Development's assessment of area and recovery factor P90's and Exploration's use of mapped isopachs tied to seismic intervals and calibrated to wells for net pay estimates.

e. *Rebuttal to "Appraising the Shenandoah Resource: Economics Post-Shen-4"*

831. **Pittinger ¶ 255:** "The Development team presented economics for the smaller resource distribution on December 17, 2015, showing negative project economics at $60/bbl pricing. The economics shown in Exhibit 65 were negative despite the wildly optimistic assumption of aquifer support with no need for injection, no degradation of well performance from asphaltene deposition, and 95% uptime. The P10 case also assumed more than 70 MMBOE/well recovery, an extraordinarily high value."

832. **Rebuttal to Pittinger ¶ 255:** First, Pittinger's use of terms such as "wildly" is inappropriate, as the availability of modest aquifer support was deemed reasonable, and asphaltenes were specifically accounted for in their calculation by including high intervention costs in their operating expenses. Second, 95% uptime is a standard uptime target that many Deepwater fields in the Gulf of Mexico operate under. Third, 70MMBOE EUR/well recovery is common in Deepwater and only amounts to ~ an average of ~10,000 BBOE/day. Given that many Deepwater wells initially produce at 20,000 – 30,000 BBOE/day or higher, this is not unreasonable.

833. Pittinger neglects to point out that these economics are burdened by over $4B in operating expenses, over $3.3B facility costs, and over $1.7B in drilling costs, all of which are

identified and targeted for additional appraisal options.[763] It is also interesting to note that the Development team compares their EURs (P50 – 350.3MMBOE) to those of the Gulf of Mexico's top-10 fields, and given its estimated size, one would expect that there would be a commercially viable economic path forward.

Top 10 Deepwater GOM Fields

	Field	EUR (MMBOE)
1	Mars	1,133
2	Ursa	399
3	Tahiti	303
4	Auger	271
5	Mad Dog	202
6	Genesis	238
7	Ariel	204
8	Shenzi	180
9	Petronius	198
10	Troika	216

Figure 94 – Anadarko Development team's comparison to Gulf of Mexico's top ten fields with their estimate of P10-P50-P90 of 717.4 - 350.3 - 223.5MMBOE, respectively[764]

f. *Rebuttal to "Appraising the Shenandoah Resource: Post-Shen-4 Cost Reduction"*

834. **Pittinger ¶ 256:** "When Shen transitioned over to Development after the drastic resource reduction and results of Shen-4, the evidence shows they were under pressure to cut costs

[763] APC-00058253

[764] *Id.* at slide 5.

to make Shen appear viable. In my expert opinion, these cost cuts and assumptions had no technical basis and Development's Shen-5 AFE presented overinflated economics."[765]

835. **Rebuttal to Pittinger ¶ 256:** Pittinger's accusation that Anadarko Development cut costs with no basis to "make Shen appear viable" has no basis. As an appraisal program nears its end, focusing on costs is very common. Most costs up to this point are "scoping" numbers that change depending upon market conditions. One would expect that the Development team to start looking more closely at each option and assumption to reduce the investment costs where appropriate. Pittinger's accusation that their work "had no technical basis" is accusatory, unwarranted, and unsupported with any documentation or references. In fact, Mr. Kleckner testified during his deposition about Anadarko's attempts to reduce capital expenditures by looking at smaller developments, less expensive facility options, and more phased approaches.[766]

836. **Pittinger ¶ 257:** "In an email exchange with McGrievy and Tule, Prosser, a reservoir engineer for Development, listed several changes made to the economic assumptions, one of which was reducing the contingency cost for facilities costs down to 14% instead of 28%. Tule, responsible for Facilities engineering, wrote to McGrievy about her concern over the lower contingency cost: '*We do not feel comfortable with a 14% contingency at this time for the facilities portion of this estimate.*'"

837. **Rebuttal to Pittinger ¶ 257:** By citing only to part of this email, Pittinger misrepresents the context of this exchange. He ignores that Mr. McGrievy responded to Ms. Thule Ham's email about cost reductions, "Bob wanted to see the economics with some assumed cost reductions that he had suggested, including looks with MODU reductions and other cost

[765] Expert Report of Lyndon Pittinger, ¶ 256.

[766] Kleckner Dep. Tr. 148:20-25.

reductions, He also wants me to set up a meeting on Tuesday, January 5th (Beattie. you, me Durkee. McDaniels, etc) for open discussion to introduce palatable ideas to reduce our cost and make sure they can be agreed upon."[767] Mr. McGrievy's email shows that he was seeking economic modeling at certain assumed cost assumptions and demonstrates a willingness to discuss ways to reduce costs.

838. **Pittinger ¶ 258:** "On the following day, McGrievy announced a team effort requested by Abendschein to address cost assumptions used for Shen economics . . . . [H]e stated that Shen's 'overall economics are extremely stressed' as quoted below:

> 'This is a high level, multi-discipline, open discussion to understand our base cost assumptions for the Shenandoah project and to identify room for further cost optimization. In light of the current poor commodity pricing environment, the overall economics are extremely stressed and we need to focus and need be reasonably confident in the investment costs that we are assuming for the project and identify opportunities to claw back on these costs. As a group. We also to make sure that we are not applying additional contingencies or double-dipping. This meeting will be a prelude to larger technical meeting with the greater Shenandoah project team to review and ground-truth our current project costs.'"

839. **Rebuttal to Pittinger ¶ 258:** This email further undermines Pittinger's assertion that Anadarko sought to reduce costs only to make Shenandoah appear economically viable, as opposed to being economically viable. As is particularly relevant, Mr. McGrievy said that the "overall economics are extremely stressed" "in light of the current poor commodity pricing environment."[768] Oil prices are a significant uncertainty and have a significant impact on the potential economic viability of a project. This email again demonstrates that the Development team was looking for solutions to ensure that Shenandoah would be economically viable and reach a final investment decision.

[767] APC-00659407.

[768] APC-00059161.

840. **Pittinger ¶¶ 259–260:** "Explaining these over-optimistic assumptions, Frye testified that her team was 'feeling pressure internally' to reduce costs so that Shen would appear more economically viable. She also testified that the assumed cost reductions were 'a big uncertainty.' . . . In my expert opinion, this cost reduction exercise resulted in simply lowering cost assumptions without successfully identifying valid and tangible ways to reduce costs. In other words, the assumed cost reductions were not based on actual cost improvements."

841. **Rebuttal to Pittinger ¶¶ 259–260:** Pittinger's statement that Ms. Frye was pressured to reduce costs to make Shenandoah "appear more economically viable" is not supported. Indeed, when Pittinger was asked during his deposition whether he interpreted Ms. Frye "to mean making it appear like we were reducing costs," Pittinger responded that it was "outside the scope of his evaluation."[769] Ms. Frye never testified that the cost reductions were only to make Shenandoah "appear" more economically viable. Ms. Frye testified that they would not arbitrarily make improvements to the economics that could not be substantiated – "*The imperative word . . . was 'if.' The reality is we did not know whether we would be able to reduce those costs*."[770] Assessing costs and discussing ways to improve the economics of a project are normal parts of the appraisal process as a project gets closer to development. The "tangible" ways that Development sought to reduce costs are well documented.[771]

[769] Pittinger Dep. Tr. 231:11-18.

[770] Frye Dep. Tr. 194:10-11.

[771] *E.g.*, APC-00659407 (McGrievy email proposing meeting to discuss ways to reduce costs); APC-00059161 (same); APC-00058398 at -464-529 (discussing concept selection and impact on costs); APC-00022625 (considering the impact of mitigation techniques on costs, discussed further below); APC-00358150 (presentation from a team designed to explore alternative development solutions to make Shenandoah more economic).

g. *Rebuttal to "Appraising the Shenandoah Resource: Post-Shen-4: Asphaltene Test Results of Commingled Oils"*

842. **Pittinger ¶ 261**: "Another major issue arose from the testing of commingled oil samples that seriously threatened the viability of commingled completions. AOP tests of commingled Shen oil samples yielded very negative results as communicated on October 21, 2015 by Fyfe with Corelab, who performed the tests. Oil samples from the LWC, LWD, and LWE zones were combined at initial pressure and temperature, and a substantial volume of asphaltene had already dropped out of solution above 19,500 psig. The constraint of having to maintain reservoir pressure above the single zone AOP was already recognized as crucial, and commingling production from multiple zones made asphaltene deposits an even worse threat to Shen's economic viability."[772]

843. **Rebuttal to Pittinger ¶ 261**: Pittinger's assessment of the impact of asphaltenes is fundamentally incomplete. During his deposition, Pittinger testified that the question of whether the "presence of high asphaltene pressures necessarily make a project noncommercial" was "outside the scope of [his] report."[773] He admitted he was not familiar with "any projects where the presence of asphaltene render[ed] the project uncommercial," "did not focus on asphaltene deposition problems outside of this field," and had never worked on a project where asphaltenes were present.[774] He also acknowledged that he did not know what projects Anadarko had worked on where asphaltenes were present or how Anadarko mitigated those projects.[775] As discussed above in my rebuttal to Pittinger's ¶ 11(g), because his assessment failed to take into account

[772] Expert Report of Lyndon Pittinger, ¶ 261.

[773] Pittinger Dep. Tr. 96:16-97:7.

[774] *Id.* at 97:14-98:16.

[775] *Id.* at 102:12-24.

fundamental information on the impact of asphaltenes, Anadarko's experience with asphaltenes, or mitigation techniques, his analysis is both flawed and incomplete.

844. As discussed in rebuttal to Merrill ¶ 90, asphaltenes are a relatively common issue that has been dealt with in GOM deepwater developments for over 20 years, Anadarko had experience with asphaltenes, including mitigating asphaltenes, and Anadarko was exploring solutions for mitigating asphaltenes at Shenandoah.

845. **Pittinger ¶ 263:** "Commingling the crude oil from three zones of Shen-2 caused the dropout pressure to rise by several thousand psi, greatly increasing the locations and conditions in which asphaltenes deposit and block flow. The unblended AOP was 11,700 psig for the LWC oil, 13,500 psig for the LWD oil, and 5,500 psig for the LWE oil, compared to the blended AOP of 19,500 psig."

846. **Rebuttal to Pittinger ¶ 263:** Pittinger focuses on the results of comingling multiple zones together may raise the AOP and or backflow into the reservoir. Pittinger's examination is incomplete. While this result is a concern to be aware of, it is one in which the development design has excellent control. There are mitigations that can be pursued, and a better understanding of different asphaltene sources by reservoir. Flows during shut-in can be managed with downhole jewelry, deposits in flowlines can be addressed with chemical injection, etc. Pittinger simply identifies this issue but never discusses the mitigations that can be employed to overcome them.

847. **Pittinger ¶ 264:** "With such a high AOP, the phenomenon of crossflow is likely to damage the reservoir when zones are commingled. When a well is shut in at the surface, crossflow occurs downhole when the formation pressures of zones open to the completion have separate pressure gradients, and the zone with the higher-pressure gradient flows into the lower

pressure zone. Formation permeability can be damaged as fluid mixes in the formation and pressure eventually depletes below the AOP of 19,500 psig. Wells need to be shut in for various reasons, so the problem of crossflow cannot be avoided and will have a significant negative impact on commingled wells."

848. **Rebuttal to Pittinger ¶ 264:** Again, these issues did not render Shenandoah uncommercial and are usually managed in a straightforward manner. First, the purpose of comingling is to match up *only* those reservoirs which are compatible with each other. Reservoirs that are not near the same pressure or which are incompatible are never comingled, as the higher-pressure zones will tend to be the only ones to produce. The comingling plan will account for shut-ins, and any backflow from one reservoir to another would be minimal. Second, any dropout that does occur is usually right at the wellbore-sediment interface which can be cleaned up with xylene soaks and careful production operations.

849. **Pittinger ¶ 265:** "Commingled completions were essential to the economic viability of the Shen field by reducing the number of production wells. If each of the eight zones in each fault block required a separate completion, the well count would need to increase by nearly an order of magnitude, and at $200-300 MM/well, drilling and completion costs would be prohibitive. Some zones could be produced sequentially, but revenue from production would be delayed and recompletion costs would rise substantially."

850. **Rebuttal to Pittinger ¶ 265:** Pittinger claims that asphaltene dropout will require each zone to be produced independently. Pittinger's extrapolation to each zone requiring its own well is unrealistic and arbitrary. Asphaltenes will require a comingling strategy and mitigation program, but these are issues that are dealt with in Deepwater Gulf of Mexico daily and with which

Anadarko has practical experience. Their Development planning group recognized and understood the issue and did not see it as an unmanageable issue.

851. Pittinger makes a number of statements describing the consequences of Shenandoah production below the AOP and the negative consequences of asphaltene dropout. However, other than pressure support, Pittinger neglects to mention the other widely utilized mitigation techniques already in common use in deepwater Gulf of Mexico, such as chemical injection. Pittinger mentions "coiled tubing cleanout" as the primary repair option available to Anadarko for asphaltene deposition at Shenandoah and fails to mention other available mitigation techniques.[776]

852. Pittinger neglects to note that the presence of asphaltenes in deepwater GOM oils is not an uncommon occurrence, and that there are several developed deepwater fields in the GOM that have successfully produced with similar oils. Pittinger's assertion that asphaltenes in the Shenandoah oils make the development of the field uneconomic is wrong, as it was recognized as an issue that would be addressed in the field development plan and reflected in the field's economics.

h. *Rebuttal to "Appraising the Shenandoah Resource: Post-Shen-4: Cost and Economic Impact of Asphaltene Deposition"*

853. **Pittinger ¶ 266:** "At flowing conditions, asphaltene deposits were expected to occur in the downhole production tubing starting at initial conditions through to depletion. With such high initial pressures (>23,000 psig), the Shen wells would flow to the surface without artificial lift for many years. As the production rises up the production tubing, both pressure and temperature decrease, inevitably reaching the AOP in all wells. Pressure decreases as the fluid

[776] Expert Report of Lyndon Pittinger, ¶ 267.

rises because less fluid lies above to support. Fluid temperature decreases because the earth's temperature cools at shallower depths. The AOP increases substantially at cooler temperatures, so cooling of produced fluid worsens asphaltene deposition. For example, the AOP measured in oil from the LWA zone in Shen-2 increased from 10,900-11,500 psig at 202°F to 19,500 psig at 135°F. Hence, asphaltene deposition will occur at some depth downhole starting at first production in all wells. Asphaltene dropout in the production tubing is confirmed in an analysis by Anadarko presented on 6/25/15 quoted as follows: '**Asphaltene deposit expected at ~11,000 ft. below mudline from day 1 of production.**'" (emphasis supplied by Pittinger)

854. **Rebuttal to Pittinger ¶ 266:** Pittinger describes a worst-case situation with no planning for mitigation and is assuming that the operator ignores the issue. This is unrealistic. These issues are managed and will be designed with more detail as the development plan progresses. The management of asphaltene issues is a well-understood issue in the Deepwater Gulf of Mexico.

855. **Pittinger ¶¶ 267-268:** "The primary remedial action available for restoring declining well performance from asphaltene deposition is coiled tubing cleanouts in which the asphaltene deposit is mechanically removed from inside the tubing and circulated out of the well. . . . The assumed total cost of these cleanouts is a function of the cost per cleanout intervention, the frequency of cleanouts, and the duration until the first cleanout is required. During the two months of December 2015 and January 2016, the assumed cost per cleanout ranged from $7 MM all the way up to $60 MM, which in my expert opinion is an inexplicably wide range and not credible. The frequency of cleanouts ranged from once every two years to every five years and longer."

856. **Rebuttal to Pittinger ¶¶ 267-268:** These estimates assume that no mitigation strategy is in place that uses either chemical injection at the completion or specially coated tubing, etc. Even Pittinger questions the "inexplicably wide range" of cost estimates and deems them "not credible." Later in his report, in his discussion of Anadarko's estimated economics of the Shenandoah project in early 2016, Pittinger makes a point of stating that, "[t]he cost reduction in asphaltene cleanouts resulted primarily from decreasing the assumption for intervention cost from $60 MM/cleanout to just $7 MM/cleanout. This case also included a 10-year delay before the first cleanout, which is overly optimistic considering the asphaltene deposition rate discussed in paragraph 271." Pittinger notes that he was "unable to find an explanation for such an extraordinary cost reduction,"[777] which fails to recognize that Ms. Frye and Ms. Prosser's initial estimates for interventions were based upon the following assumptions:[778]

- A P90 case of 14 well cleanouts over the life of the field
- A P50 case of 20 well cleanouts over the life of the field
- A P10 case of 40 well cleanouts over the life of the field

857. These estimates were done assuming a wet tree intervention with a MODU (Mobile Offshore Drilling Unit) at an estimated cost of $60MM each. These early estimates were then updated via more detailed calculations referenced in the following:

	Wet Tree Cost ($MM)			Dry Tree Cost ($MM)		
Intervention Type	Low	**Base Case**	High	Low	**Base Case**	High
1W/D) Production Log (PL)	29.7	37.1	65.0	2.0	2.5	4.4
2W/D) Coiled Tubing Cleanout + PL	44.8	56.0	98.0	4.7	5.9	10.2
3W/D) Acid Job + PL	48.7	60.9	106.6	5.1	6.4	11.1
4W/D) Xylene Job + PL	48.7	60.9	106.6	5.1	6.4	11.1

[777] *Id.* ¶ 292 p. 125.

[778] APC-00059276.

Figure 95 – Intervention estimates from Ms. Frye and Ms. Prosser. The "Coiled Tubing Cleanouts" are specifically for addressing asphaltene dropout.[779]

858. Again, this chart shows the huge difference in estimated intervention costs for wet trees vs. dry trees. The documentation showing the details of these estimates are included in the reference.

859. **Pittinger ¶ 269:** "The negative economics presented in Exhibit 65 were based on a total intervention cost of $2.4 billion over the life of the field to remove asphaltene deposits in the wellbore, making it the second largest cost category behind facility costs. Exhibit 66 details the cost categories of this evaluation and provides some of the key assumptions, such as five years to first intervention, one intervention every five years and $60 MM/intervention."[780]

860. **Rebuttal to Pittinger ¶ 269:** While Pittinger criticizes the early production assurance plans and costs that Development planning was considering, he neglects to note that the numbers he quotes for costs are the based upon an early "worst case", wet tree, P10 scenario. As discussed in response to Pittinger ¶ 268, these early estimates were then updated via more detailed calculations. The $2.4 billion intervention estimate that Pittinger references was for interventions based on a wet tree, P10 case ($60MM x 40 interventions). The P50 and 90 intervention estimates were $1.2 billion and $840 million, respectively.[781]

861. **Pittinger ¶ 270:** Pittinger then claims that "intervention frequency was identified as the single most important uncertainty impacting both upside and downside value. Following this evaluation, assumptions for intervention frequency and costs varied widely with

[779] APC-00022625.

[780] Expert Report of Lyndon Pittinger, ¶ 269.

[781] APC-00059276.

extraordinarily large improvements unaccompanied by any technical explanation for the basis of the improvement."[782]

862. **Rebuttal to Pittinger ¶ 270:** Again, with mitigation strategies and with other intervention options, the cost of interventions would fall significantly giving rise to significant cost improvements. Anadarko discussed possible efforts to reduce costs, including implementing mitigation tactics.

863. **Pittinger ¶ 271:** "Exhibit 67 provides evidence that these results were based on very biased and optimistic assumptions. Increased compartmentalization was listed as the second most important driver of downside loss but was not even mentioned in the list of upside drivers of value. This imbalance of significant downside but no upside risk and uncertainty demonstrated that the base case had no upside with respect to compartmentalization and plenty of downside. In my experience as a manager of economic evaluations, this lack of balance fails the simple test of whether a key assumption has a comparable amount of upside as downside. In my expert opinion, this economic evaluation showing negative results failed to capture just how negative the risked economics of the Shen field were."

864. **Rebuttal to Pittinger ¶ 271:** Pittinger opines that "these results were based on very biased and optimistic assumptions" in referencing the Development team's identified "Economic Drivers" in Exhibit 67, but these are not optimistic assumptions but areas where additional resources need to be targeted. Pittinger's claim that "a key assumption has a comparable amount of upside as downside" is simply incorrect. There are many distributions that have unequal upsides and downsides, and the resource volume was just one of them. Pittinger argues that the economic evaluation is "flawed" because it only captures the upside and not the downside. But,

[782] Expert Report of Lyndon Pittinger, ¶ 270.

if Pittinger sees the evaluation as "flawed" it is his interpretation that differs from the technical staff that performed it. Again, Pittinger is simply unfairly characterizing interpretive judgments with which he disagrees as "flawed."

865. **Pittinger ¶ 272:** "The assumed frequency of tubing cleanout for the more expensive intervention cost of $2.4 billion was once per five years as shown in Exhibit 66. An Anadarko presentation on asphaltene mitigation was sent to partners on April 5, 2016 with an estimate for the rate of asphaltene deposition: 'Asphaltene deposition at the rate of ~2 bbl /~20,000 bbl of oil flow'. At this rate of deposition, a well producing 5,000 BOPD for five years would yield 912 bbls of asphaltene deposits. An oilfield barrel is 5.6 ft.3, so that volume would equate to 5,100 cu. ft., enough asphaltene deposits to fill 9 miles of production tubing with an inside diameter of 4.5 inches. At an initial rate of 15,000 BOPD, a well could produce enough asphaltene deposits to fill a mile of production tubing in less than 70 days. Only a few hundred feet of blockage would require a cleanout intervention, so blockage could occur in days, weeks, or months, with a small chance of producing trouble-free for five years. In my expert opinion, this asphaltene deposition rate was a major threat to the viability of a Shen development and the assumption of five years between needing cleanout was extremely optimistic."

866. **Rebuttal to Pittinger ¶ 272:** Pittinger's calculation is unrealistic as it implies that any hydrocarbon accumulation with asphaltenes would be basically unproducible. This is an incorrect and overly simplistic approach, as it assumes no mitigation and uniform distribution of asphaltenes in the tubing. Additionally, this approach reflects Pittinger's lack of experience with asphaltenes in Deepwater Gulf of Mexico.[783] Any asphaltene deposition inside of the tubing shows up very quickly as the effective inside diameter of the tubing begins to shrink. Coated pipe can

[783] Pittinger Dep. Tr. 96:11-102:24.

help keep the deposits from "sticking" to the walls of the pipe. Chemical injection at the completion can keep the effective dropout pressures high. Insulated or heated pipes can help prevent dropout. Pressure support from either aquifer or injector wells can keep pressure up. There are a host of strategies that can be employed that make Pittinger's calculated prediction highly unrealistic.

867. **Pittinger ¶ 273:** "Another factor negatively impacting economics is well downtime from asphaltene deposits plugging the production tubing and flowlines. As stated in paragraph 265, asphaltene deposition will occur downhole in Shen producers from the day of first production. This deposition will plug the tubing and cause oil rates to drop, resulting in substantial delays and losses in production. Mobilizing a rig to perform the tubing cleanout can take months, resulting in additional downtime. In my expert opinion, the assumption of 90-95% uptime for wells to produce at their assumed rates is unrealistically optimistic given the volume of asphaltene deposits discussed in the previous paragraph. This case also assumes no degradation in well performance due to deposition in the reservoir, which is very optimistic given the complex faulting observed in Shen-4."

868. **Rebuttal to Pittinger ¶ 273:** Because Pittinger does not consider the possibility of mitigation, let alone their impact on uptime, his opinion that 90 to 95% uptime is an "unrealistically optimistic" assumption is based on an inadequate foundation. Pittinger does not opine on what an appropriate uptime would be—with or without any applied mitigations or interventions. Moreover, Anadarko recognized facility uptime was unknown,[784] and the 90-95% estimate was included as an assumption for a "dynamic simulation"[785] to test the economics of a wet tree

[784] APC-01446937 at -017.

[785] *See* Pittinger Dep. Tr. 227:5-11 (when questioned regarding his understanding of this term, Pittinger testified: "I do not know exactly how to describe what they mean by dynamic simulation assumptions.").

solution.[786] The same presentation notes that "[u]ncertainty" about the impact of asphaltenes on well deliverability and recovery, as well as completion and intervention costs, would be "[h]andled in [d]ynamic [m]odeling and [e]conomics."[787] In other words, there is nothing to suggest Anadarko considered this to be a final estimate of uptime, particularly since Anadarko did not yet know the extent of asphaltenes in the reservoir. If this assumption was as troublesome of an issue as Pittinger suggests, one would think that the partners' technical experts would have raised a concern; Pittinger does not point to any evidence this was viewed as problematic.

i. *Rebuttal to " Appraising the Shenandoah Resource: Post Shen-4BP1 and Reconciliation"*

869. **Pittinger ¶¶ 274-275:** "Johnson wrote an email to Pachman regarding overwhelming evidence of structural complexity. In my expert opinion, this structural complexity was ignored in Exploration's evaluation of the uncertainty on the eastern side of the structure and assuming pressure continuity between Shen-4 ST1 and Shen-3. . . . "

870. **Rebuttal to Pittinger ¶¶ 274–275:** In the email cited by Pittinger, Mr. Johnson is referring to the structural complexity in the area of Shen-4 ST1 and is making an argument for the drilling of Shen-4 ST2. Mr. Johnson is not referencing the area to the east of Shen-2.[788] Pittinger does not explain why he believes this email suggests structural complexity to the east that at this point was unsupported by the evidence. Pittinger's conclusion that "this structural complexity was ignored in Exploration's evaluation of the uncertainty on the eastern side of the structure and assuming pressure continuity between Shen-4 ST1 and Shen-3" is not shared by either the Exploration or Development teams or by Anadarko's partners.

---

[786] APC-00058253 at slide 3.

[787] *Id.* at slide 15.

[788] APC-00057599.

871. **Pittinger ¶¶ 277–280:** "On January 5, 2016, McGrievy clarified that the Development team was then responsible for evaluating the Shen project and called a meeting to resolve the significant differences between the two groups . . . . His main priority was to focus on the P90 area. . . . "The P99 estimate for the eventual area of the oil accumulation should represent the smallest outcome possible, which should have included the downside of a heavily compartmentalized scenario based on how much evidence Shen-4 provided regarding faulting. In my expert opinion, 400 acres per well is far too large of a drainage area per well for estimating the P99 heavily faulted, minimum outcome."

872. **Rebuttal to Pittinger ¶¶ 277–280:** In preparation for their RCT Meeting, both Exploration and Development prepared their justifications. Pittinger quotes a number of exchanges where Mr. McGrievy argues for the two teams to arrive at a single consensus on volumes. Pittinger then makes the argument that an Exploration proposed P99 area value to be used in the MMRA software was too large. Mr. Camden had argued that each well that penetrated oil could drain a conservative 400 acres (Shen-1, Shen-2, and Shen-4 ST1), and that 1200 acres for a P99 was a reasonable estimate. Pittinger argues that 400 acres per well is too large, implying that the fault blocks are smaller than that. Pittinger cites no evidence in support of his claim other than the potential of unseen dense faulting across the entire reservoir. Typical Deepwater drainage areas are much larger than this.

873. **Pittinger ¶¶ 281–284:** "The internal audit function of the Risk Consistency Team ('RCT') facilitated an effort to resolve the differences between the two groups in a meeting on January 11, 2016, the result of which was to model the east and west sides of the field with separate one-layer MMRA files and combine the two with a multizone model that included a risk factor of 75% chance of success applied to the eastern side. Frye wrote an email describing the meeting as

coming to an agreement, but that Exploration felt the low side was too low, and the Development team still believes the low side is too high with the agreed version referred to as the 'Joint Model.' Exhibit 69 compares key assumptions in the Joint Model to the previous evaluations for both teams."

874. **Rebuttal to Pittinger ¶¶ 281-284:** This joint assessment by the two teams represents their joint interpretations and assessment of risks and uncertainties. As with both of the interpretations before it, it has strengths and weaknesses and the teams' best assessment of recoverable volumes. Pittinger does not critique this version of volume estimation, but uses a number of paragraphs to give a detailed description of its results.

875. **Pittinger ¶¶ 285-288:** "The agreement between Exploration and Development did not last long. The January 20, 2016 GOM Exploration Engineering Activity Report had the comment under Shen-4 as follows: 'Team is building a revised MMRA to reflect a P99 case based on Exploration interpretation.' A pair of revised Exploration resource evaluations were shown in Exhibit 70 on January 26, 2016. . . . Two new Exploration fault model cases were presented, one with a mean of 550 MMBOE and the other with a mean of 590 MMBOE."

876. **Rebuttal to Pittinger ¶¶ 285-288:** Pittinger overstates the evidence when he says that the post-RCT agreement "did not last long." The very exhibit that Pittinger shows includes the post-RCT joint fault estimate. The Exploration-only estimates provide a helpful comparison. However, as Pittinger notes in paragraph 289, the joint estimate was presented to the Executive Committee as part of the Shen-5 AFE process.

877. **Pittinger ¶¶ 289-290:** "A presentation on January 21, 2016 titled 'Shenandoah 5, WR 51 #4 Appraisal Well Proposal' for Kleckner provides an economic evaluation based on the joint model resource geologic distribution (untruncated mean of 426 MMBOE). These economics

were also presented to the Executive Committee on February 1, 2016 as part of the Shen-5 AFE approval process. The Multizone model result . . . provides a distribution truncated below a commercial cutoff of 200 MMBOE. The range of economic outcomes was combined in a probability-weighted decision tree with four branches, appraisal failure (<200 MMBOE), a P90 case (263 MMBOE, a P50 case (434 MMBOE), and a P10 case (717 MMBOE). . . . The economic evaluation results . . . [showed] the risked mean representing the chance-weighted result of four branches of the decision tree. At a $60/bbl price, the net after-tax net present value was $208 MM with a PIR10 of 0.22, less than Anadarko's corporate threshold. These economics assumed that aquifer support was sufficient to avoid asphaltene dropout and that no injection wells were required. In my expert opinion, this was a very optimistic assumption given the evidence from Shen-4 that proved compartmentalization on an extraordinarily small scale. This evaluation substantially overstated the project's economic potential by excluding the impact of compartmentalization on production, pressure maintenance, need for injectors, EUR/well, recovery efficiency, and asphaltene dropout in the reservoir, production tubing and flowlines."

878. **Rebuttal to Pittinger ¶¶ 289-290:** As discussed several times throughout this report, Pittinger's reliance on a supposed "corporate threshold" PIR is flawed. The purpose of calculating the PIR during appraisal is to identify which uncertainties have the most significant impact on the financials of the project so that the appraisal team can focus their appraisal efforts, staff time, and money on the most impactful work. Testimony has shown that PIR10 was "a general guideline,"[789] and certainly not the only criteria to be considered. Pittinger also claims that these "economics assumed that aquifer support was sufficient to avoid asphaltene dropout and that no injection wells were required" when in fact these calculations included mitigations for

[789] Hollek Dep. Tr. 53:11-19.

asphaltene dropout, and accounted for weak aquifer support in their choice of recovery factor, now reduced to 13.8%.

879. Pittinger also fails to recognize that, based upon these volumes, this model clearly shows an 88.2% chance for appraisal success for volumes above 200 MMBOE.[790] This is in conflict with his opinion that, by this point, Shenandoah was not commercial. Mr. McGrievy agreed with this point in his deposition, testifying that there was an 88% chance of appraisal success, and that 200 MMBOE was the threshold to economically support a "standalone spar facility with the given oil price of $60/bbl."[791] Mr. McGrievy also testified that Development felt very positive about the success of the field and supported drilling Shen-5 and Shen-6 to understand the rest of the resource.[792] Ms. Frye also testified that she believed that an FID at Shenandoah depended on the results of Shen-5 and Shen-6.[793]

880. Importantly, the slide shows an economic evaluation at an $80 assessment with a PIR over 0.3. When asked, whether the $80 case had "any relevance when considering commercial viability," Pittinger responded that the base case was "much more important" and that he "would venture to say the $80 case is completely irrelevant."[794] When asked why, if it was irrelevant, it would be calculated, he responded, "To show the sensitivity to a higher oil price environment in case they had hopes of oil prices recovering perhaps. But that's speculation and that's outside the scope of my report."[795] However, Anadarko's documents show that it modeled various economic

[790] APC-01166104 at slide 34.

[791] McGrievy Dep. Tr. 284:17-285:24.

[792] *Id.* 285:25-286:16.

[793] Frye Dep. Tr. 291:21-292:6.

[794] Pittinger Dep. Tr. 240:4-14.

[795] *Id.* 240:15-23.

sensitivities at different oil prices. Mr. Camden attested that at Anadarko PIRs were often modeled at different oil prices and based on different inputs, which allowed appraisal teams to understand how changing these factors could impact the profitability of the project.[796] Experts in the oil and gas industry know that the potential profit of a project depends heavily on the price of oil, and sensitivities like this provide better insight into how commercial the project might be at other oil prices.

881. Pittinger claims that "evidence from Shen-4 that proved compartmentalization on an extraordinarily small scale" when it only demonstrated potential for such faulting in areas proximal to the salt wall, and any significant faulting had not been seen in either Shen-2 or Shen-3 wells. Pittinger wrongly claims that this "evaluation substantially overstated the project's economic potential by excluding the impact of compartmentalization on production, pressure maintenance, need for injectors, EUR/well, recovery efficiency, and asphaltene dropout in the reservoir, production tubing and flowlines." All of these were considered, accounted for, and included in the team's volume assessment and development plan. Pittinger's argument is internally inconsistent, as he contends that these factors reduce recovery factor from 30% to ~14%, yet also argues that they are not accounted for. Pittinger does not provide his own estimates of the proper economics. Pittinger's opinion minimal review of the work done, is inconsistent with the opinions of a team of professionals who applied their best technical work to arrive at this assessment.

882. **Pittinger ¶ 291:** "These economics, which were prepared for the Shen-5 AFE approval review . . . improved substantially over the uneconomic December 17, 2015 results provided in Exhibit 65, but the improved economics still failed to meet the 0.3 PIR10 corporate

[796] Camden Declaration ¶¶ 4-5.

threshold referred to in Hollek's deposition. Part of the improvement resulted from the 40% increase in the Development's mean resource size from 304 MMBOE to 426 MMBOE that followed from the reconciliation meeting on January 11, 2016 discussed in the previous section. The cost reduction initiative discussed in Paragraph 255-259 resulted in a very substantial $1.6 billion reduction in the assumed costs of asphaltene clean out interventions, and a $110 MM/well reduction in drilling and completion costs. Exhibit 74 compares key cost assumptions between the December 17, 2015 and January 21, 2016 evaluations."

883. **Rebuttal to Pittinger ¶ 291:** As already discussed, the PIR10 is not a firm threshold for a development decision, let alone an appraisal decision. The actions that Pittinger describes, including efforts to better understand intervention costs and account for dropping rig rates, improved economic projections. This is a typical part of the process of moving a project toward development.

884. **Pittinger ¶ 292:** "The cost reduction in asphaltene cleanouts resulted primarily from decreasing the assumption for intervention cost from $60 MM/cleanout to just $7 MM/cleanout. This case also included a 10-year delay before the first cleanout, which is overly optimistic considering the asphaltene deposition rate discussed in paragraph 271. I was unable to find an explanation for such an extraordinary cost reduction. In my expert opinion, this reduction appears to be the result of management direction and not based on sound engineering work."

885. **Rebuttal to Pittinger ¶ 292:** As already discussed in response to Pittinger ¶¶ 267-268, Ms. Frye's numbers are based on different assumptions to account for the uncertainty in the field.. The assumptions and intervention costs were well documented. There is no support for Pittinger's accusatory statement that "[i]n [his] expert opinion, this reduction appears to be the result of management direction and not based on sound engineering work." While Pittinger attacks

Ms. Frye's economic analysis, the body of Anadarko documents demonstrates the staff's best technical work over many years as made available, and in my technical opinion, there is no evidence supporting any lack of technical integrity among them. Pittinger offers no support for this accusation or cites any evidence or references that support this accusation.

886. **Pittinger ¶ 294:** "The economic comparison of wet vs. dry completions essentially hinged on intervention costs from asphaltene deposition. Wet tree completions are substantially more expensive to workover, given their location more than one mile below the water surface. If interventions are few, wet tree completions might be more economical, but if asphaltene issues are numerous and recurrent, then dry trees would be less costly. In my expert opinion, the wet tree vs. dry tree evaluation required a realistic assessment of intervention costs to make the right decision on which development concept to pursue. The January 20, 2016 Shen-5 AFE evaluation may have been more subject to senior management's pressure to reduce cost assumptions."[797]

887. **Rebuttal to Pittinger ¶ 294:** Pittinger's economic assessments are not valid. Pittinger claims that "[t]he economic comparison of wet vs. dry completions essentially hinged on intervention costs from asphaltene deposition" when the intervention costs difference between the two options was only ~$700,000 and the Fixed/Variable/PHA Fees difference was a much larger $2,500,000. His statement that "[t]he January 20, 2016 Shen-5 AFE evaluation may have been more subject to senior management's pressure to reduce cost assumptions" is another undocumented, unsupported accusation. These is no evidence that Development staff "made up" any of these numbers or assessments. All evidence points to staff working to the best of their technical ability.

[797] Expert Report of Lyndon Pittinger, ¶ 294.

888. **Pittinger ¶ 295:** "Intervention costs had been flagged as the most important driver of value the month before as shown in Exhibit 67, yet Anadarko simultaneously maintained two extraordinarily different cost assumptions that varied by a multiple of 3.4. Both economic evaluations were for important decisions, and in my expert opinion, there is no apparent reason for maintaining such widely different cost assumptions for economic evaluations."

889. **Rebuttal to Pittinger ¶ 295:** Cost models can change quickly and significantly over time as better information or different choices are brought to bear. Many early cost numbers are based upon general "charts" without significant technical work having yet been done on them. As resources are directed to certain parts of the cost components, more detailed and appropriate and cost-effective choices can be made that significantly impact the values. Different costs models are maintained depending upon remaining uncertainties, thus driving the direction of the appraisal program.

890. **Pittinger ¶ 296:** "A week after Exploration revised its resource evaluation upward, ignoring the RCT downward adjustment."

891. **Rebuttal to Pittinger ¶ 296:** As explained above, Exploration's revisions, which appear to have been to establish a more apt comparison to pre-Shen-4 estimates, had no impact on the ongoing appraisal or evaluation effort at Shenandoah. With the handover, Anadarko's Development team's assessments and resource evaluations were now the ones driving the appraisal AFE and Development planning process.[798]

892. **Pittinger ¶ 297:** "McGrievy wrote to David Janise, Manager of Planning for the Gulf of Mexico, about the transition of Shen from Exploration to Development, and his concern that Exploration was much more aggressive in their resource assessment and economics."

798 APC-00660240.

893. **Rebuttal to Pittinger ¶ 297:** It is common for Exploration teams to have more optimistic resource assessments and economics. And while Mr. McGrievy may have been "concern[ed]," he commented that "Bob D. [Daniels] didn't appear to have any problems with [Development's] take on reserves."[799] In my expert opinion, an exploration executive like Mr. Daniels would have understood that differences like this were common between the Exploration and Development teams' assessments.

894. **Pittinger ¶ 298:** "Camden updated Exploration's overly optimistic version of the economics on February 9, 2016 in the following slide showing a mean resource size of 550 MMBOE post-Shen-4, down 40% from the pre-Shen-4 volume of 920 MMBOE. At $60/bbl, the after-tax net present value discounted at 10% was $675 MM, more than triple the value shown in the Development case in Exhibit 73 above. The discounted profit to investment ratio of 0.70 was also more than three times higher than Development's result of 0.22, signifying a much more optimistic representation by Exploration."

895. **Rebuttal to Pittinger ¶ 298:** Again, it would not be unusual for Exploration and Development to have different economic assumptions. Pittinger neglects to point out that one of the most significant contributors to Exploration's better view of the economics is their cost model which only includes net CAPEX of ~$2B, where Development is using CAPEX values that are approximately twice as large.[800]

j. *Rebuttal to "Appraising the Shenandoah Resource: Shenandoah's Viability Was in Serious Doubt at Least by December 2015"*

896. **Pittinger ¶ 299:** "In my expert opinion, Shen was [an] uneconomic venture following the negative results from Shen-4 according to Anadarko's corporate threshold, and

[799] APC-00665185.

[800] APC-00225661; APC-01166104, at slide 34.

Anadarko senior management shared this view according to several internal documents. Shen's economic viability was in serious doubt by December 2015 and persisted into 2017. The economics presented on December 17, 2015 showed negative returns, despite multiple optimistic assumptions as discussed in paragraphs 254. The following paragraphs show documents that establish Anadarko senior management negative view after Shen-4 and persisting up to condemning results from Shen-6."

897. **Rebuttal to Pittinger ¶ 299:** Again, Pittinger's view relies upon the incorrect assumption that a PIR10 of less than 0.3 at any point throughout the appraisal made a project uncommercial. The "general guideline" of 0.3 was directed at making major investment decisions, not for assessing an uncertain resource while appraisal was still underway. While Pittinger claims that "[t]he economics presented on December 17, 2015 showed negative returns" but he neglects to acknowledge that the economics presented in January 2016 showed positive returns. Economic projections can and do change throughout the appraisal process as information is gained and cost assumptions are better understood.

898. While Pittinger claims that "Anadarko senior management shared this view according to several internal documents," these documents also show that no decision had been reached on the commercial viability of Shenandoah while the appraisal was still underway and the Development was team still working toward achieving economic development options. When asked what he meant by "serious doubt," Pittinger testified, "[s]erious doubt is not a technical term. Just [that] there was a lot of doubt expressed, a lot of negative comments."[801] However, when asked whether he reviewed any documents or testimony "where anyone explained why Anadarko was continuing to appraise Shenandoah even though its viability was in serious doubt,"

[801] Pittinger Dep. Tr. 241:24-242:2.

Pittinger clarified that he had not seen any and that "[o]pining on the motivations is beyond the scope of [his] report and calls for speculation."[802] In other words, Pittinger himself disavowed any understanding of why the project would have gone forward; the documents clearly reflect that it went forward because there was still significant upside that needed to be explored through additional drilling.

899. **Pittinger ¶ 300:** "On February 1, 2016, McGrievy emailed a presentation to Kleckner that addressed strategic options going forward with the Shen appraisal program. Issues identified in Exhibit 77 included remaining resource uncertainty, more appraisal wells required, the 180-day drilling clock, partner alignment, new technology development required for high pressures, and an unfavorable seller's market given COP's unsuccessful sales effort."

900. **Rebuttal to Pittinger ¶ 300:** This February 2016 presentation sent by Mr. McGrievy to Mr. Kleckner outlined the range of issues facing Shenandoah and the strategic options available. Such a highlighting of issues helps frame all options going forward, and this type of assessment is typically done for every asset on a regular basis. An outlining of each option and evaluation of the risks and benefits[803] of them is always part of ongoing portfolio management. Mr. McGrievy testified about this "Strategic Options" slide, saying that if "reserves that could be established by Shen-5 and Shen-6 . . . would have been wildly economic."[804]

901. **Pittinger ¶¶ 303–305:** "On February 5, 2016, Walker expressed reluctance to proceed with further appraising the Shen field. . . . The significantly less attractive economics following Shen-4 likely impacted senior management's enthusiasm. Kleckner responded to

[802] Id. at 245:17-246:8.

[803] APC-01180900.

[804] McGrievy Dep. Tr. 237:9-25.

Walker with the comment below that a better assessment of fabrication costs could enhance value in 'an exit or sell down/promote case.. . . . With options such as exit, sell-down, or promote, senior management investigated ways to reduce their exposure to risks of proceeding with the development of the Shen field, especially after the complex results from Shen-4. . . . Walker responded to Kleckner that he did not want to proceed with the facilities trip to Finland because a Shen sanctioning decision was years away based on recent results from Shen-4 and its sidetracks. He saw no way Anadarko would want to proceed with a Shen development."

902. **Rebuttal to Pittinger ¶¶ 303–305:** Pittinger mischaracterizes the exchange between Mr. Kleckner and Mr. Walker. Mr. Walker never indicates he is reluctant "to proceed with further appraising the Shen field" or that he has less "enthusiasm" as a result of Shen-4. Rather, the exchange, which was about a trip to Finland to assess potential Shenandoah facility options, clearly reflects that Mr. Walker was interested in deferring such a trip until the path forward on Shenandoah was clear, *i.e.*, when they were closer to making a decision on development.[805] Kleckner highlighted the progress the teams were making toward deciding on a production solution saying that "Integrated Project Teams are working solutions on all aspects of Shenandoah to determine concept selection and costs as part of economic evaluation done in appraisal scoping exercises"[806] and that "[t]his team is trying to get a yard assessment to complete the scoping exercise."[807] He added that even in "an exit or sell-down/promote case, our value can be enhanced with valid solutions and estimates for development cost."[808] Selling down ones interest is a normal response to reduce risks and is common in the Gulf of Mexico Deepwater (*e.g.*,

[805] APC-00668987.

[806] *Id.*

[807] *Id.*

[808] *Id.*

Shell selling Mars interests to BP). Mr. Walker did not say there was "no way Anadarko would want to proceed with a Shen development" generally, but that they were still "several years away from this type of decision based on what you showed us recently . . . and I see no way we will want to take this to development today with a production solution." [809] However, he emphasized that "[s]hould #5 drill out successfully" they would "need to reconsider this."[810]

903. Mr. Walker's deposition testimony further supports this. Mr. Walker testified that such a trip was beyond just his approval and would require partner approval, that his concern included the uncertainty between whether the "production solution should be between a spar and a semisubmersible," and that the trip was "premature."[811] Mr. Walker also testified that the leadership team had always modeled an exit strategy for Shenandoah in their dynamic portfolio as an option to upgrade their portfolio in the Gulf of Mexico further, as they had done with many other discoveries and fields.[812] Mr. McGrievy also testified about their consideration concept of an "exit strategy." He indicated that they would always consider all of the alternative options, but at this point, they felt that they should go forward with Shenandoah.[813]

904. Pittinger ignores this testimony completely. In fact, during his deposition, he testified that he did not recall Mr. Walker's testimony and that interpreting it would be beyond the scope of his report.[814] He further testified that whether it was possible Mr. Walker "meant we

---

[809] *Id.*

[810] *Id.*

[811] Walker Dep. Tr. 221:12-222:15.

[812] *Id.* at 226:5-17.

[813] McGrievy Dep. Tr. 286:23-287:14.

[814] Pittinger Dep. Tr. 160:18-162:6.

would not take it to Development today as opposed to at some point in the future," was "outside the scope of [his] report because it calls for speculation."[815]

905. **Pittinger ¶ 306:** "Other indicators established low market value and that partners were heading to the exit door. On March 31, 2016, the sale of Marathon's 10% interest in Shen to Venari was announced, establishing a basis for fair value. The sales price was $7 MM at closing and $15 MM if Venari proceeds with the final investment decision (FID). Some AFE balances were also included in the transaction but assumed to be small relative to the purchase price. Assuming a 50% chance of proceeding after FID, the risk weighted fair value is estimated at $14.5 MM for the 10% working interest, which would indicate Anadarko's 30% interest might have had a comparable sales value of just $43.5 MM, significantly less than the carried book value. All remaining partners exercised their preferential rights to increase their working interest. In my opinion, Anadarko was probably pursuing a strategic consolidation for resale value."

906. **Rebuttal to Pittinger ¶ 306:** Pittinger points to Marathon's exit from the partnership as an indicator of the field's lack of commerciality. However, as Pittinger notes, Anadarko and Venari exercised their right to *increase* their working interest, indicating that they viewed Shenandoah as having commercial value and that more of it was better. Pittinger's "risk weighted fair value estimation" is inaccurate because it does not fully account for the overrides that are in place from the amended sales of interests.[816]

907. **Pittinger ¶ 307:** "In a presentation titled 'Forward Plan Formulation – EC Discussions,' one of the items discussed by the Executive Committee on April 26, 2016 was 'Shenandoah development case with significantly lower economic performance.' This statement

[815] *Id.* at 243:24-245:15.

[816] ANACOP00000890.

demonstrates that senior management recognized and discussed the negative changes in the economics of developing the Shen field following Shen-4. Shen was disinvested in four out of the six scenarios, shown on page 14 of the presentation."

908. **Rebuttal to Pittinger ¶ 307:** Pittinger claims that an April 2016 Executive Committee Portfolio modeling exercise demonstrated their negative view on Shenandoah. This was an evaluation of different "cases" and how they might affect the portfolio, and did not represent either the most likely or preferred case. Mr. Gwin testified about why companies conduct these portfolio-wide modeling exercises – "to stress test [the assets]" and "to figure out how to best allocate capital."[817] Pittinger ignores the two scenarios in which Shenandoah would receive funding—these indicate that it had potential commercial value.

909. **Pittinger ¶ 308:** "In a strategy development meeting on June 13, 2016, the Executive Committee compared four scenarios, three of which excluded further investment in the Shen project. To exclude Shen investment from three out of four scenarios reflects a low amount of confidence held by senior management in the economic viability of a Shen development."

[817] Gwin Dep. Tr. 224:3-13.

CONFIDENTIAL

Figure 96 – The overall agenda for the Strategy Development Meeting that tested numerous portfolio strategies.[818]

910. **Rebuttal to Pittinger ¶ 308:** Pittinger selectively references only some of the Portfolio Scenario Meetings, during which Anadarko considered multiple scenarios. Mr. Gwin testified that these scenario builds were part of a broad portfolio and strategic review process.[819] Pittinger concludes that "[t]o exclude Shen investment from three out of four scenarios reflects a low amount of confidence held by senior management in the economic viability of a Shen development." Pittinger fails to explain how funding in one scenario is consistent with his view that Shenandoah was uncommercial. He also fails to explain how his view is consistent with the

---

[818] APC-01362172 at slide 2.

[819] Gwin Dep. Tr. 216:18-217:6

presentation from June 27 , the "Recovery Scenario," which indicates that Shenandoah is "funded in all cases."[820]

911. **Pittinger ¶ 310:** "In a presentation titled '2016 Strategy Development – Executive Committee Update,' dated July 5, 2016, the top weakness of the Shenandoah Project was identified as 'Current development economics challenged.' Exhibit 78 from the same slide shows that the Executive Committee considered the Shen asset as having no value and states so very explicitly. In my experience, senior management would also have been aware of the considerable book value being carried by this valueless asset."

Key Play Statistics	
Net Revenue / Working Interest	28% / 35%
Undeveloped Resource, Net (MMBOE)	113
2016 Capital Allocation ($MM)	108
Base Case NAV @ $60/$2.75 ($B)	0.0

Figure 97 – Pittinger's Exhibit 78: Key Play Statistics.[821]

912. **Rebuttal to Pittinger ¶ 310:** It is inaccurate to conclude that Shenandoah "ha[d] no value." This slide shows only the "current state" of the Shenandoah post-Shen-4 appraisal with only 113 MMBOE currently identified as developable. It makes no sense to presume that even though Shen-5 and Shen-6 had not been drilled yet, Anadarko would have been required at that point to determine the commerciality of the field. In an August 2016 presentation to the Board of

[820] APC-01362523 at 19.

[821] APC-01363508 at 17.

Directors, after the Shen-5 appraisal, Shenandoah is shown as providing "long term growth" and as having value,[822] again representing the status as of the appraisal.

913. **Pittinger ¶ 311:** "Further evidence of Anadarko senior management having lost confidence in the commercial viability of proceeding with developing the Shenandoah Field is provided in an email exchange between Executive Committee members. In a summary of key points from a recent portfolio modeling exercise, Hollek states the following with Walker and Gwin copied in the exchange: '4. Under both scenarios, the model chooses not to invest in Shenandoah, and it is deactivated post-2017.'"

914. **Rebuttal to Pittinger ¶ 311:** Again, Pittinger appears to misunderstand the purpose of an economic model. As discussed earlier, Shenandoah received funding in some modeling scenarios but not others. This email does not suggest any decision has been made as to Shenandoah's commerciality. While Pittinger suggests this represents "lost confidence in commercial viability," this email exchange was in response to announced drilling rig growth targets in the Delaware Basin and the source of required capital to make it happen. There is no discussion of the economic viability or development of Shenandoah, as appraisal was still underway.

915. **Pittinger ¶ 312:** "In March 2017, McGrievy informed Abendschein that the EC discussed a substantial write-down of the net book value carried by the Shen asset in December 2016. This write down demonstrated that Anadarko senior management did not view Shen as a going concern and therefore action was required to address the impairment of an uneconomic asset."

[822] APC-00784657 at slides 91-92, 105.

916. **Rebuttal to Pittinger ¶ 312:** Pittinger's characterization of McGrievy's email is misleading, because he improperly interprets the write-down at Shenandoah as an admission that the field as a whole was "uneconomic." As an initial matter, in this March 2017 email, McGrievy relayed third-hand information, saying only, "I understand, talking with Luis, that Chris Champion did set the stage with some of the executive team in December, 2016 to let them know that a fairly substantial write-down at Shenandoah would be imminent in 2017."[823] A writedown like the one contemplated here is in response to a book value consideration that needs to be addressed, such as the reduction in resources due to an appraisal. This process does not automatically mean the relevant asset is entirely uneconomic as Pittinger suggests; it simply means that it is smaller than previously estimated. Relatedly, Pittinger admitted during his deposition that "how much of a write-down fairly substantial means" is "beyond the scope of [his] report."[824]

917. **Pittinger ¶ 313:** "In my expert opinion, if economic scenarios included the downside potential that reflected the information available at this time regarding fault compartmentalization and asphaltene deposition in the reservoir, production tubing and flowlines, further appraising the Shen discovery would have been uneconomic after Shen 4. The economic scenarios appear disconnected from the growing reality of fault compartmentalization, minimizing the chances of adequate pressure support from an aquifer. Senior management appeared to be working from a more pessimistic perspective regarding Shen's commercial viability than were represented in Anadarko's economic evaluations."

918. **Rebuttal to Pittinger ¶ 313:** Pittinger makes no economic calculations to support his conclusion. His statement is misleading as information regarding fault compartmentalization

[823] APC-00307805.

[824] Pittinger Dep. Tr. 269:10-16.

was accounted for in explicit fault mapping and lower recovery rates (13.8% instead of 30%). Asphaltene deposition was accounted for with mitigations and interventions built into the development plan. Economics were built with modest aquifer support from a proven large downdip aquifer. Pittinger's statement that "[s]enior management appeared to be working from a more pessimistic perspective regarding Shen's commercial viability than were represented in Anadarko's economic evaluations" is completely unsupported; they were working from a "portfolio view" and were waiting to make a final decision based upon the results of the Shenandoah appraisal program. Pittinger's expert opinion is in conflict with the technical staff and management at Anadarko and with partners ConocoPhillips, Cobalt and Venari, who all continued to see commercial value in Shenandoah and continued to invest in the appraisal program.

F. Shen-5

1. Well Results

919. The Shen-5 appraisal well, also referred to as WR 51 #4, was the first appraisal well managed by Anadarko's Development team. Ms. Frye, a member of Anadarko's Development team, submitted the AFE to approve Shen-5, and the Development team presented the AFE to the Executive Committee.[825] Shen-5 was designed as a "producer well"—meaning that it was engineered to be used as a producing well if Anadarko sanctioned the project. Shen-5 was spud on March 14, 2016, and finished drilling around August 17, 2016.[826]

920. Soon after operations commenced at Shen-5, Marathon exited the partnership and sold its 10% working interest at Shenandoah, to be divided between 7% to Venari and 3% to

[825] APC-00222712; APC-00667721; APC-00223098.

[826] APC-00675736; APC-00082675.

Anadarko. This set the new partnership's interests at 33% for Anadarko, 30% for ConocoPhillips, 20% for Cobalt and 17% for Venari.[827]

921. The pre- and post-Shen-5 estimated volume ranges were determined to have changed minimally, from Pre-Shen-5 P90/mean/P10 estimates of approximately 180/425/690 MMBOE to Post-Shen-5 P90/mean/P10 estimates of 134/353/663.[828] ConocoPhillips estimated mean resource remained nearly unchanged at 303 MMBOE.[829]

2. Structure Mapping

922. Shen-5 pressure data showed that Shen-5 was fault-separated from both Shen-1 and Shen-2.[830] This result was unsurprising, since a north-south fault in the oil column between Shen-2 and Shen-5 had already been interpreted from seismic data,[831] and there was strong evidence of Shen-1 being in a separate, rafted block.[832] Development's updated structure map following Shen-5, depicted below in **Figure 98**, was essentially the same as before Shen-5 was drilled and largely in agreement with partner maps, which also remained relatively unchanged.[833]

[827] APC-01229949 at slide 3; ANACOP00001027; ANACOP00000558.

[828] APC-01228541 at slide 73-74.

[829] ANACOP00009420 at slide 7.

[830] APC-01228875 at slide 15.

[831] APC-00648353 at slide 4.

[832] APC-00259884 at slide 7.

[833] APC-01228875 at slide 5.

CONFIDENTIAL

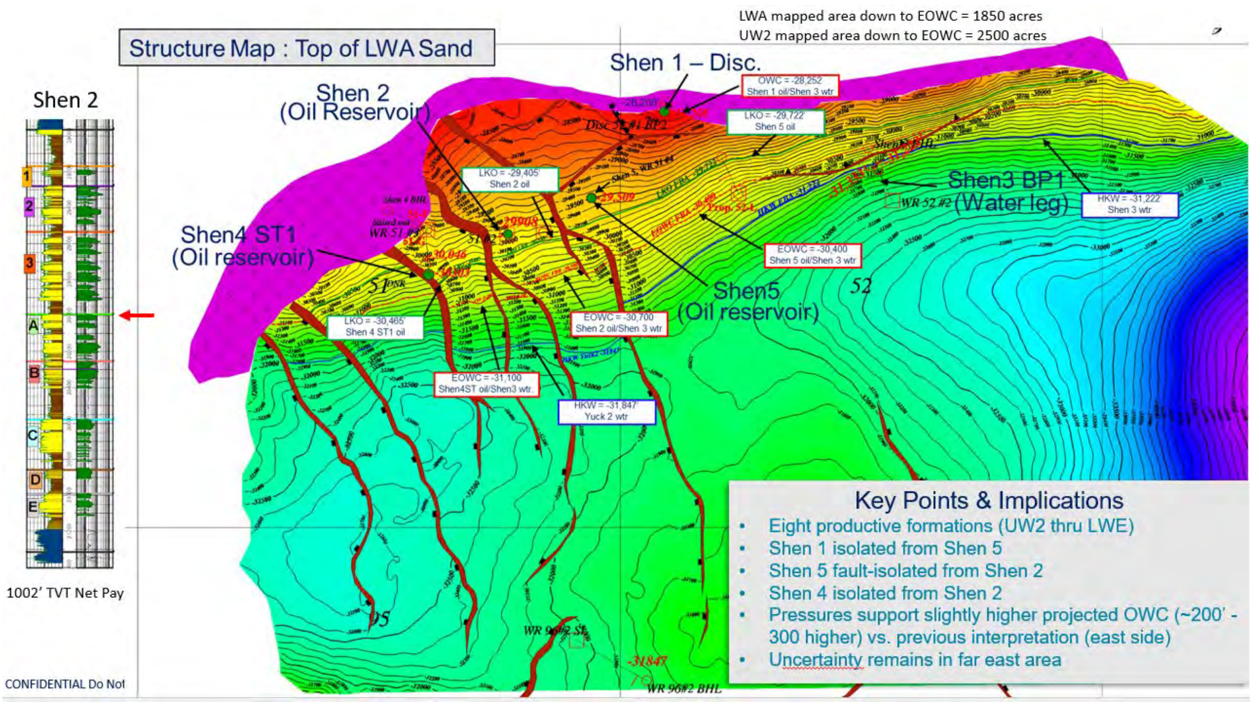


Figure 98 – Anadarko Development structure map after Shen-5 was drilled. There were no significant structural changes to the map other than the projected OWCs for the eastern fault block (Shen-5 and Shen-3) moved approximately 200 feet shallower by projecting from oil pressures in Shen-5 and water pressures in Shen-3.[834]

[834] APC-00259884 at slide 7.

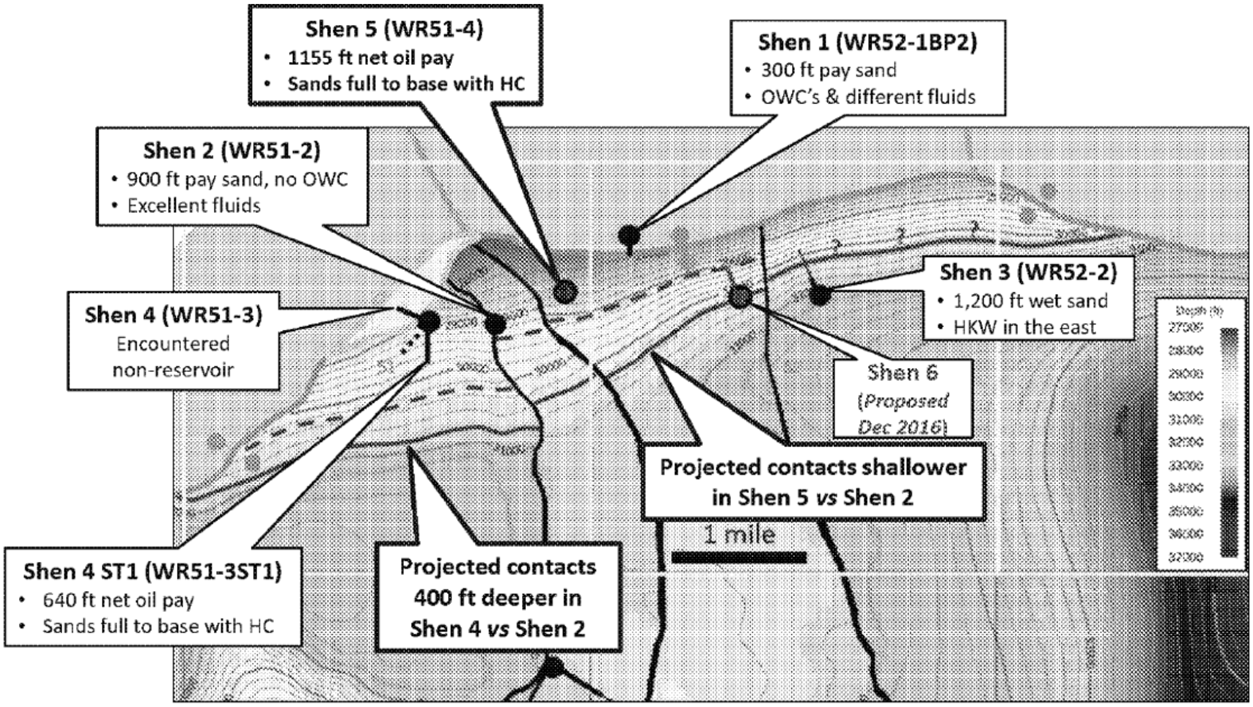


Figure 99 – ConocoPhillips' map after the Shen-5 well was drilled. ConocoPhillips made no effective structural changes to their maps other than to adjust the projected OWCs to the east based upon oil pressures in Shen-5.[835]

923. The Shen-5 well was designed to penetrate oil up-dip and to the east of Shen-2.[836] One of the objectives was to "[d]e-[r]isk" the large volume uncertainty to the east, rather than to penetrate the OWC.[837] The Shen-5 well found all sands filled-to-base with oil as expected. However, oil pressures in the Shen-5 well were lower than those measured at Shen-2,[838] again implying that a fault separated the oil in Shen-5 from the oil in Shen-2,[839] and that the projected OWCs in the Shen-5 fault block were slightly shallower than those in the Shen-2 fault block. These slightly shallower OWC estimates were then also used to move the projected OWC for the

[835] ANACOP00007385 at slide 5.

[836] APC-00063752 at slide 8.

[837] *Id.* at slide 7.

[838] APC-01229949 at slide 7.

[839] APC-01228875 at slide 15.

eastern fault blocks slightly shallower. But once again, these OWC projections still relied on pressure data from the Shen-3 well. *See* Figures below.

924. Pressure data in the oil from Shen-5 when compared with pressures from Shen-3 also led Anadarko to raise the projected OWC on the fault blocks in the eastern side of the field by approximately 200 to 300 feet, although it did not resolve the uncertainty in the far eastern part of the field up-dip of Shen-3. Anadarko continued to use pressures from Shen-3, the only well to penetrate the aquifer sands, to estimate the OWC for the Shen-2 fault block (UW2 - 30,400'ss), the Shen-5 fault block (UW2 - 30,200'ss) and the Shen-4 ST fault block (UW2 - 31,000'ss), and to choose the Shen-6 well location.[840]

925. The western fault blocks at Shenandoah, including the block with Shen-4 ST, show estimated OWC and Highest Known Water (HKW) levels initially projected from the Shen-3 well, again supporting the interpretation that all of these fault blocks are in downdip pressure communication through their connected aquifer. The Anadarko Development team recognized that even if the faults that separate the oil into different producible compartments are sealing, unless they compartmentalize a reservoir into a completely sealed container, they will still pressure communicate through their aquifer connections. This recognition of connectivity through the downdip aquifer was consistent throughout the appraisal program.[841]

---

[840] *Id.* at slide 5.

[841] APC-01314375 at slide 31.

CONFIDENTIAL

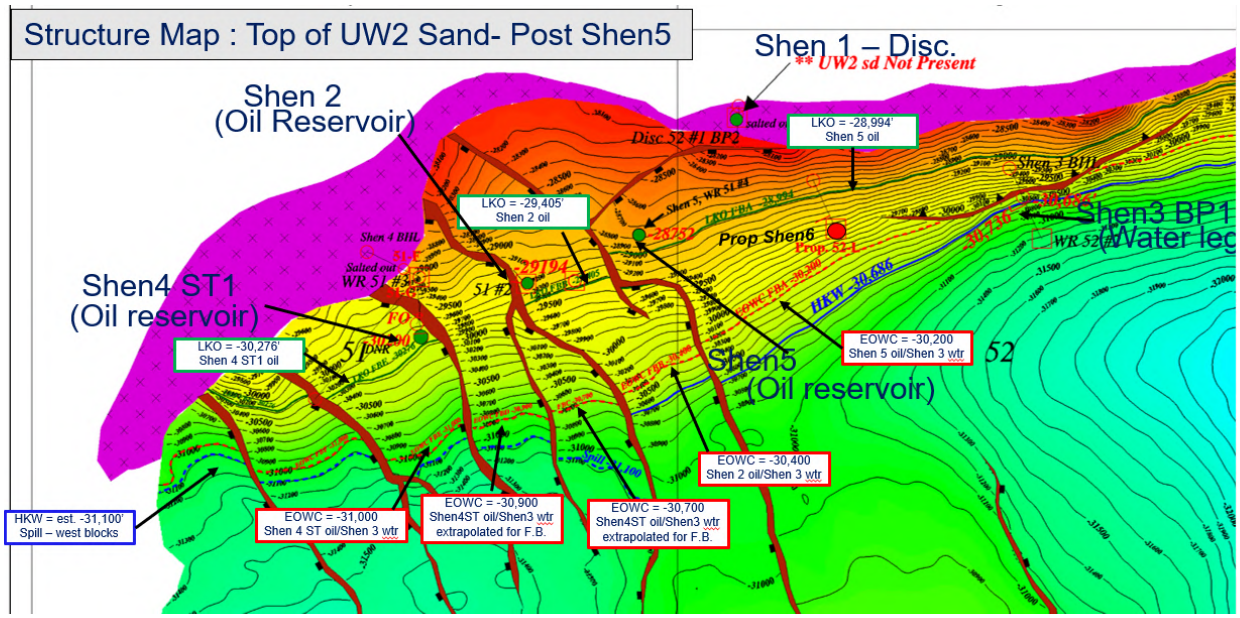


Figure 100 – Development structure map showing estimated OWCs that follow consistent contours across many of the faults and projected OWCs using oil pressures from one fault block with water pressures from another fault block, both of which demonstrate an interpretation of a common downdip aquifer.[842]

926. Development's map after Shen-5 was drilled indicates that the Development team was using Shen-3 pressure gradients.[843] However, even this map—which was made with the data from updated seismic imaging and data from the eight well penetrations from Shen-1 through Shen-5 and which shows interpreted faults with some of fault blocks demonstrating different OWC depths—still shows that each fault block is connected to the aquifer in the center of the basin. In fact, since Shen-2 and Shen-5 wells are both filled-to-spill but at different pressure gradients, and the projected OWC for each block is still based upon the water pressure gradients in the Shen-3 well, again assuming that these blocks are connected through the aquifer.[844] Anadarko and its

[842] APC-01314375 at slide 31.

[843] APC-00263016 at slide 7 (showing fault between Shen-2 and Shen-5 (and thus, between Shen-2 and Shen-3) and noting that "OWC's vary between fault blocks").

[844] APC-00263016 at slide 7.

partners consistently demonstrated this interpretation methodology until even after the Shen-5 well was drilled.

927. ConocoPhillips continued the assumption of fault blocks having common downdip aquifers. However, it now interpreted the eastern aquifer (represented by water pressures in the Shen-3 well) to be separate from the western aquifer (represented by water pressures in Yucatan #2 well). In spite of the Yucatan-2 and Shen-3 water pressures being in close agreement with each other, ConocoPhillips chose to use water pressures from the most proximal corresponding wet well with the oil pressures of each fault block to derive projected OWCs for each of the fault blocks. See **Figure 101** below.

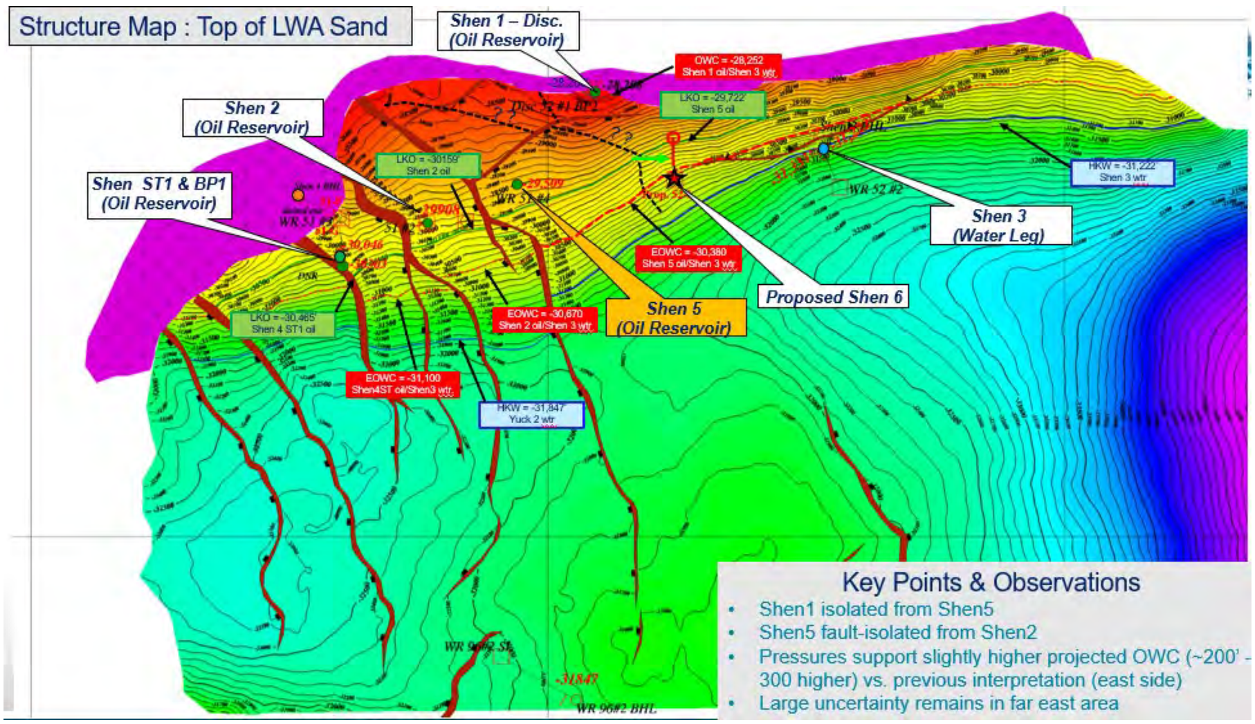
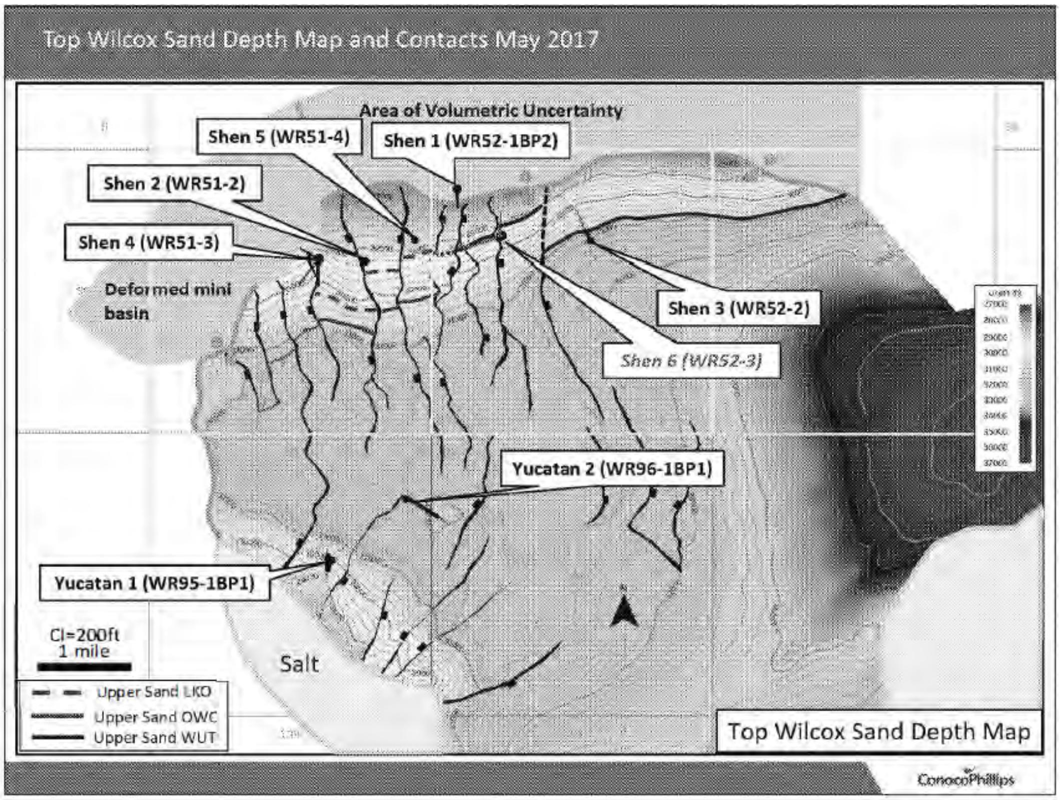


Figure 101 – Anadarko Development Post-Shen-5 map indicating HKW, LKO, and estimated OWCs for each fault block. OWCs are mapped using Shen-3 water pressures and the oil pressures from each individual fault block.[845]

[845] APC-00084788 at slide 4.

CONFIDENTIAL



Faults modified on the 2016 final data, top structure and original faults on the WG data.
[redacted]
Contacts in Shen 5 and East fault blocks from Shen 3 water pressures
Shen 2 30,392
Shen 4 30, 829
Shen 5 30,321

Figure 102 – ConocoPhillips' post-Shen-5 map with estimated OWCs.[846]

928. Given the success and lack of surprises at Shen-5, the partnership proceeded with the drilling of Shen-6 at the proposed "L" location as had been previously discussed. This well was also intended as a future development well.

3. <u>Alleged Misstatements</u>

a. *Amended Complaint ¶ 132: "The Shenandoah-5 well encountered more than 1,000 feet of net oil pay and expanded the eastern extent*

[846] ANACOP00024798 at slide 3.

of the field . . . ."[847] (emphasis supplied by Plaintiffs)

b. *Amended Complaint ¶ 133: Anadarko was "real pleased with what [they] saw in the number 5 well. Not surprised but [they] were very pleased to see it come in as [they] had precited it would, 1,040 feet-plus of pay."[848] (emphasis supplied by Plaintiffs)*

c. *Amended Complaint ¶ 138: "The [Shenandoah-5] well encountered more than 1,040 net feet of oil pay, extending the resource in the central-to-eastern limits of the field."[849] (emphasis supplied by Plaintiff)*

929. At several points during the Class Period, Anadarko discussed the results of Shen-5. During a July 27, 2016 earnings call, Walker discussed the net pay of Shen-5. He stated that the Shen-5 well "encountered more than 1,000 feet of net oil pay and expanded the eastern extent of the field."[850] He said that Anadarko was "real pleased with what [they] saw in the number 5 well. Not surprised but [they] were very pleased to see it come in as [they] had predicted it would, 1,040 feet-plus of pay."[851] In its February 2017 10-K, Anadarko described Shen-5, saying that it "encountered more than 1,040 net feet of oil pay, extending the resource in the central-to-eastern limits of the field."[852]

930. Shen-5 encountered 1,043 feet of oil filled-to-base in the Upper and Lower Wilcox reservoirs that correlated closely with the Shen-2 well, and confirmed laterally continuous sands as were seen in Shen-2 and Shen-3.[853] Proved oil east of the Shen-2 well extended confidence in additional oil in place to the east. The measured oil pressures in Shen-5, when used with the Shen-

[847] Dkt. 55 – Amended Complaint, ¶ 132.

[848] *Id.* ¶ 133.

[849] *Id.* ¶ 138.

[850] *Id.* ¶ 132; APC-00704016 slide 8

[851] *Id.* ¶ 133.

[852] *Id.* ¶ 138.

[853] APC-01228875 at slides 4; 7.

3 water pressures to project an OWC, indicated a Shen-5 downdip OWC above that estimated at the Shen-2 well.[854] The rock and fluid properties from the appraisal wells all indicated exceptional well and reservoir performances at Shenandoah that would exceed any other Paleogene Wilcox field being developed in the Gulf of Mexico, including higher porosities, higher permeabilities, higher pressures and higher GORs.[855]

931. Shen-5 substantially met Anadarko's pre-drill objectives. Anadarko had set the following pre-drill objectives for the Shen-5 well:[856]

> "Confirm Hydrocarbon Rock Volume, North and East of Shenandoah 2
> De-Risk Area of Largest Volumetric Uncertainty
> Understand Lateral Reservoir Connectivity in Oil Column
> Gather additional fluid, Geochem[istry], and reservoir pressure data.
> Further Constrain Depositional Model for Wilcox Reservoirs"

These pre-drill objectives were also summarized for the Executive Committee as follows:[857]

> "Extend Wilcox proven reservoirs to the east
> Confirm fault model by pressures relative to Shen 2 and Shen1
> Move project closer to a minimum economic field size for sanctioning"

932. Anadarko's public statements regarding the Shen-5 well are consistent with these objectives.

d. *Amended Complaint ¶ 124: [Statements during a May 24, 2016 UBS Global Oil and Gas Conference] "And as we've continued to move forward with Shenandoah, drilling Shenandoah 5 now, we've gotten even more excited about the upside and the potential here as we move toward development."*[858] *(emphasis supplied by Plaintiffs)*

"[W]hen you look at Shenandoah, it goes without saying that it's the – it is the finest lower tertiary discovery to date in the Gulf of Mexico, and I say that because of a few reasons. When you're

---

[854] APC-01228875 at slide 14.

[855] APC-00704016 at slide 11.

[856] APC-00063752 at slide 7.

[857] APC-00067336 at slide 1.

[858] Dkt. 55 – Amended Complaint, ¶ 124.

> *looking at these resources potentially, you look at a couple things. One, you look at thickness, two, you look at area, and then, three, recovery factor. (emphasis supplied by Plaintiff)*
>
> *And when you look at this log and you can see that 100-foot scale bar on there, that's 1,000 feet of sand full of hydrocarbons, so it's – one, it's extremely thick. Two, when you look at the scale across those blocks – and you can see the northern part there – this spans nine miles. Those are three-mile blocks, so you're talking about something that has a lot of area, which is really the biggest driving factor when you talk about size.*
>
> *And then the last thing is the recovery of this. And so this particular discovery had Miocene-like properties, which means that the reservoir quality is very good. You're looking at porosities of up to 25% here. You're looking at permeabilities in the 100 millidarcy range. Some of the individual sands see 300, 400 millidarcies perm. And then the last thing you look at is the fluid property, since it's very light oil out here. So from the overall discovery, it's got everything that you're looking for."* [859]
>
> *"You should take some comfort that we're committed to the development out here. The last two wells that we drilled are keeper wells, which means that when we take this to production, we will be able to produce from those well bores."*[860] *(emphasis supplied by Plaintiff)*
>
> *¶ 126: "So Shen 5 is a material derisking of what we're doing."*[861] *(emphasis supplied by Plaintiff)*

933. During a May 24, 2016 UBS Global Oil and Gas Conference, Bob Gwin and Shandell Szabo discussed the early results of the Shen-5 well. As explained above, the Shen-5 well encountered a significant amount of net pay and extended the size of the field to the east. During the presentation, Anadarko showed a slide describing the Shenandoah appraisal program:

[859] *Id.*

[860] *Id.*

[861] *Id.* ¶ 126.

CONFIDENTIAL

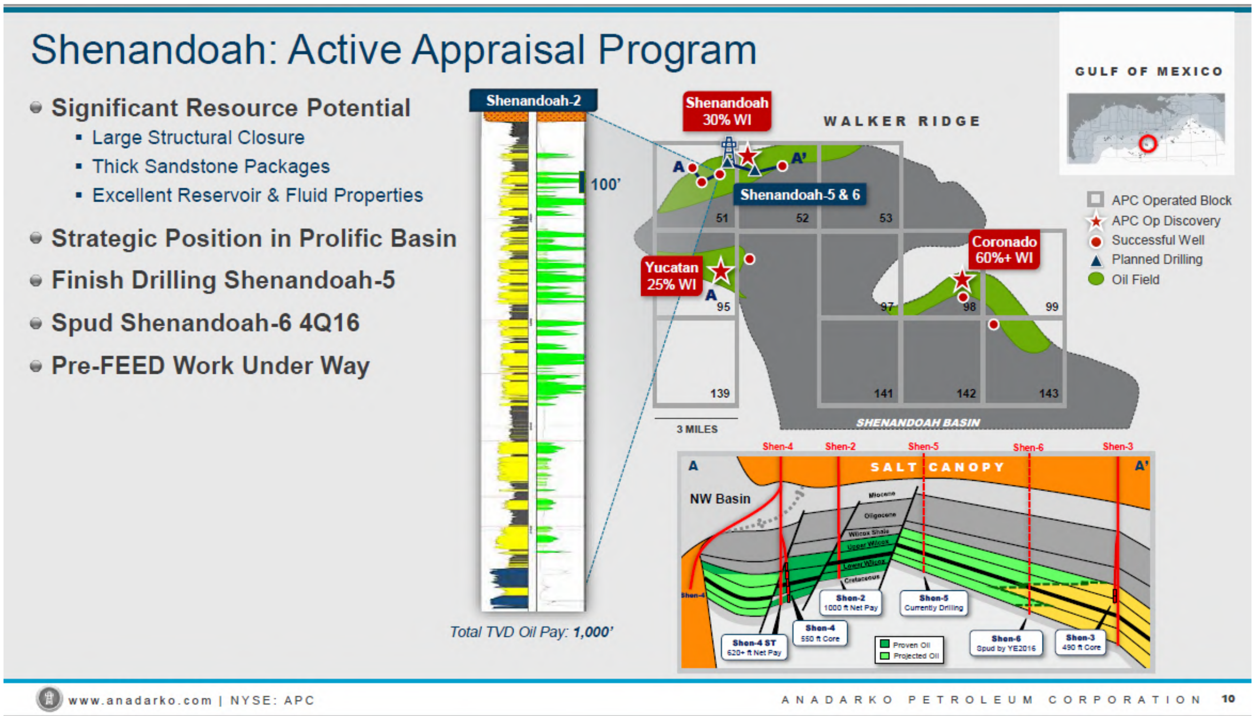


Figure 103 – Slide from the May 24, 2016 UBS Global Oil and Gas Conference showing each of the Shenandoah appraisal wells including the still-drilling Shen-5 well and the future Shen-6 well.[862]

934. The slide includes a cross-section showing the Shenandoah project. This slide indicates, among other things, that the original Shen-4 well drilled into salt, that the Shen-4 ST encountered 520 net feet of pay; that Shen-4, Shen-2 and Shen-5 were separated by faults; and that Shen-3 did not encounter oil. It also indicates fault blocks where there is "proven oil" (Shen-2 and Shen-4) and fault blocks where is only "probable oil" (Shen-5 and Shen-6), as well as areas where there is no oil (the location of Shen-3).

935. During this conference, Ms. Szabo accurately described the fluid properties encountered at Shenandoah. The porosity values in the Shen-4 Bypass well were in the 15%-25% range, as displayed in the following figure.

[862] May 24, 2016 Presentation at UBS Global Oil and Gas Conference at slide 10.

CONFIDENTIAL

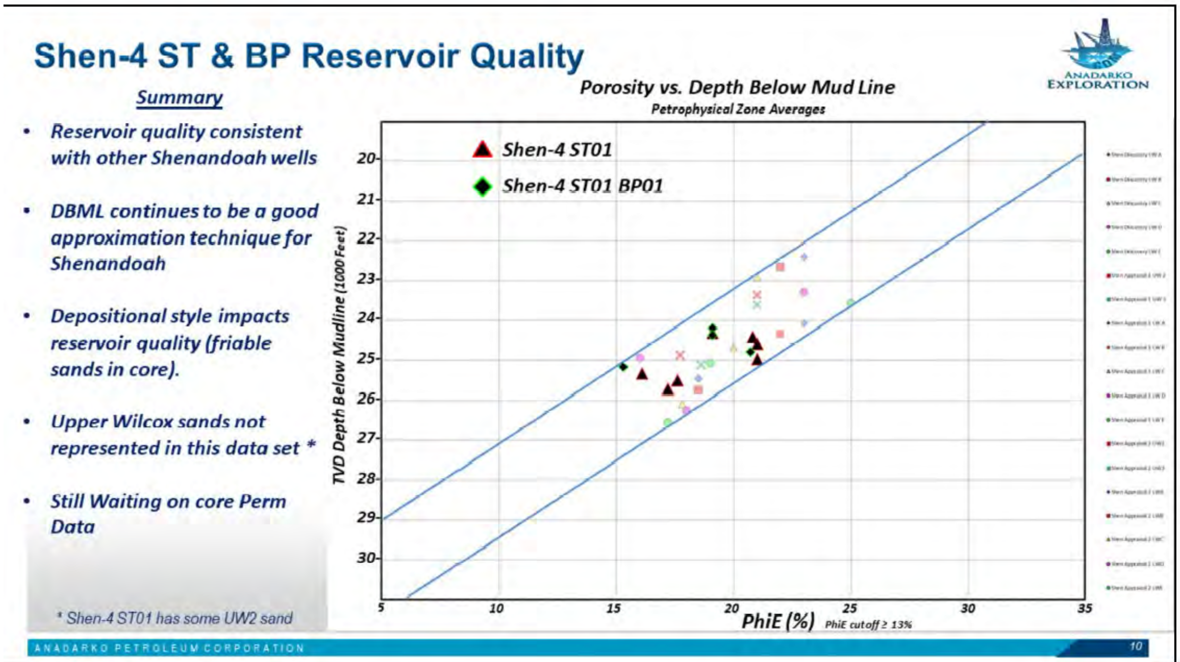


Figure 104 – A plot of porosity values from Shen-4 ST1 and Shen-4 ST1 BP as a function of depth demonstrating the high porosity value preserved in the Wilcox reservoir sands.[863]

936. As discussed previously, and depicted in **Table 2**, above, comparing the properties measured at Shenandoah with other Lower Tertiary discoveries in the Deepwater Gulf of Mexico demonstrates that Shenandoah's average porosity and gas-oil-ratio were much better than previously seen, and that the average measured Shenandoah permeability was at the higher end of the other fields.

937. Additionally, the rock quality properties from other Lower Tertiary discoveries can be compared to the rock properties encountered at Shenandoah.

[863] APC-00065685 at slide 10.

CONFIDENTIAL

Well	Zone	MD (Ft)	P res (Psia)	T res (F)	API (SSF)	GOR (scf/stb)	Viscosity (cp) Res Cond	AOP (Psia) @ Tres
Shen 1	LW D – LW E	29,348 – 29,620	22,635 – 22,892	190	26.1 – 26.3	852 – 867	3.07 – 3.36	8,465 – 8,635
Shen 2	UW 2 – LW B	29,329 – 30,323	22,798 – 23,185	197 -207	32.9 – 33.6	1,202 – 1,332	0.84 – 0.89	11,496 -11,908
	LW C	30,589	23,301	210	35.4	1,448	0.48	11,719
	LW D	30,892	23,497	212	36.6	1,819	0.49	13,480
	LW E	31,068	23,663	214	24.3	734	1.19 – 3.5 (IFA)	5,545
Shen 4	UW 2 – LW B	30,603 – 30,953	23,220 – 23,348	209-213	32.6 – 34.2	1,264 – 1,424	0.74	12,570
	LW C	31,296 – 31,503	23,359 – 23,701	217 – 219	37.3 – 37.4	1,840 – 1,949	0.44	14,012
	LW E	No sample or IFA – using gas isotope evaluation, fluid properties assumed to be similar to Shen 2 LW E						
Shen 5	UW 1 – LW B	28,754 – 29,910	22,569 – 22,982	183 – 201	29.1 – 32.7	1027 – 1217	1.15 – 1.92	12,290 – 12,996
	LW C – LW E	30,236 – 30,759	23,103 – 23,418	203 – 214	23.7 – 27.6	690 - 780	Results not yet available	

▪ **Shen 5 - Samples measured for H2S in each sand – results show no detectable H2S**

Table 15 – A summary of reservoir and oil properties measured from each of the Shenandoah wells.[864]

938. Comparing the properties measured at Shenandoah with other Lower Tertiary discoveries in the Deepwater Gulf of Mexico demonstrates that Shenandoah's average porosity and gas-oil-ratio were much better than previously seen, and that the average measured Shenandoah permeability was at the higher end of the other fields. Shen-5 provided important information about the Shenandoah resource and reduced the uncertainty of the project. In doing so, it was a "material de-risking" of the project.

4. <u>Rebuttal to Merrill Opinions re: Shen-5</u>

939. **Merrill Opinion re: Shen-5:** Merrill opines that Shen-5 encountered tar, which presented a risk to commerciality, and that Anadarko misled the public about the results of the well.

940. **Rebuttal to Merrill Opinion re: Shen-5:** Merrill overstates the risks of the Shen-5 results. Tar is common in deepwater Gulf of Mexico fields,[865] is typically not laterally

[864] APC-00002305 at slide 14.

[865] APC-00219133 at p. 1.

extensive,[866] and can be mitigated. As to the public statements, Merrill makes inapt comparisons between the results and the public statements; while the public statements do not include all details about the well results, the disclosed results were reported accurately.

941. **Merrill ¶¶ 92, 18(e):** "[T]wo tar zones were noted in the Shen-5 Lower Wilcox C zone. In total, there was about 22 feet of tar. Such tars form by water-washing and biodegradation in the reservoir and form flow barriers." "Tar posed a serious risk to the commercial viability of Shen."

942. **Rebuttal to Merrill ¶¶ 92, 18(e):** Although Merrill claims in his report that "Tar posed a serious risk to the commercial viability of Shen," he indicated otherwise in his deposition where he deferred questions concerning the impact of tar in wells to a reservoir engineer:[867]

> "Q Does the presence of tar limit the ability altogether to develop a prospect?
> A That's a question for an engineer.
> Q Are there steps to mitigate the presence of tar or is that a question for an engineer?
> A Again, I'd have to refer to my reservoir engineer.
> Q Are you familiar with any projects in the Gulf of Mexico that have been terminated because of tar?
> A Not to my knowledge."

943. While Shen-5 did encounter tar, that was not particularly surprising given that "patchy" tar had previously been encountered sporadically, and was not consistent in each Shenandoah well.[868] Anadarko had already been encountered tar at other Deepwater Gulf of Mexico fields (Big Foot, Mad Dog, etc.).[869] In each case, the tars were patchy, not laterally extensive, and would have been expected to have limited impact on production. These other

[866] SPE/IADC 105619, 2007, M.H. Weatherl, ("[E]xperience shows that tar in deep water Gulf of Mexico tends to be limited in size, often penetrated in one well but not another a few hundred feet away.")

[867] Merrill Dep. Tr. 194:6-16.

[868] APC-00191621 at p. 6.

[869] APC-00219133.

operators, who had fields with poorer reservoir and fluid properties, understood the mitigations that could be applied and successfully dealt with these same issues.[870]

944. Internal documents indicate that Anadarko and the partners appropriately acknowledged the presence of tar, accounted for it in the resource recovery estimates,[871] and sought to understand the impact of it on a development solution.[872] In my opinion, the presence of tar was not fatal to the commerciality of Shenandoah, and I am not aware of any documents or testimony indicating that Anadarko or any of the partners considered it as such.

945. Additionally, Merrill's attribution of tar to "biodegradation in the reservoir" is not correct. Biodegradation of hydrocarbons is the breakdown of the organic hydrocarbons by living organisms, such as bacteria. It cannot occur at these pressures and depths since there are no bio-organisms located there. Biodegradation of oils occurs in much shallower layers nearer the seafloor where bacteria and other living organisms can colonize and survive.

946. **Merrill ¶ 92:** "Completed in August 2016, Shen-5 drilled in what Anadarko and partners considered the eastern block (Figure 32). The well drilled through the expected fault, confirming it to be in the eastern block. The well was cored, and well logs determined over 1,040 ft of net hydrocarbon pay in the Upper and Lower Wilcox zones. Pressure data indicated varying fluid composition and vertical pressure variation, similar to previous wells. . . . Anadarko's statements about Shen5 were in terms of the feet of pay, focusing on the magnitude of pay, and ignored compartmentalization and production issues that typically decrease resources per well and production."

[870] IADC/SPE 111600, 2008, G. Han, et. al. ("Many operators such as ConocoPhillips (Spa Prospect), Chevron (Big Foot), BP (Mad Dog) have reported bitumen encounters.")

[871] APC-00044392 at slide 36.

[872] *See, e.g.*, APC-01282251 at slide 51; ANACOP00024814 at slide 4; APC-00081279; APC-00705528; APC-00081302; APC-00267881

947. **Rebuttal to Merrill ¶ 92:** Merrill implies that Anadarko's statements about Shen-5 misled the public. However, Merrill does not dispute that the fact that Anadarko's statements about Shen-5 were factually true. Shen-5 found over 1,000 feet of light oil, an objectively large amount of oil in an appraisal well. Merrill's criticism that Anadarko's statements focused "on the magnitude of pay, and ignored compartmentalization and production issues that typically decrease resources per well and production" is misleading, since any compartmentalization issues that may arise would have been addressed by the development plan, and flow assurance/production issues can be addressed with reservoir surveillance and mitigation intervention techniques (which Anadarko was studying). Companies do not typically release details on expected resources per well that they would expect to produce. Accordingly, Merrill's suggestion that Anadarko "ignored" these issues internally, or should have presented them publicly, are both improper conclusions.

948. **Merrill ¶ 95:** "Anadarko held out Shen as having excellent reservoir and fluid qualities to the public. For example, at a May 24, 2016, UBS Global Oil and Gas Conference ('UBS Conference'), Anadarko's representative Shandell Szabo described Shen as having 'Miocene-like properties, which means that the reservoir quality is very good. You're looking at porosities of up to 25% here. You're looking at permeabilities in the 100 millidarcy range. Some of the individual sands see 300, 400 millidarcies perm. And then the last thing you look at is the fluid property, since it's very light oil out here. So from the overall discovery, it's got everything that you're looking for.' But the data showed the average porosity for Shen-2, Shen-3, and Shen-4 ST-1 was 20%. Further, as discussed above, Shen posed serious challenges as to tar and AOP."

949. **Rebuttal to Merrill ¶ 95:** While Merrill challenges Anadarko's statement of reservoir and fluid quality, the well results confirmed that Shenandoah did in fact have very good

reservoir quality – better than other Gulf of Mexico Lower Wilcox developments. The reservoir is reported for Shen-5 as, "Shen5 Properties Compare favorably to Shen2. Phi's [porosity is] slightly higher at Shen2 but SW's [water saturation is] lower at Shen5. N/G [net-to-gross shows] improvement at Shen5. K [permeability is] superior at Shen2,"[873] with improved mobility at Shen-5.[874] As discussed above, Ms. Szabo accurately described the porosities at Shenandoah. While Merrill notes that the "average porosity" was 20%, Ms. Szabo did not claim to describe "average porosity."

950. As also discussed above, the challenges presented by tar and asphaltenes were not unusual in the Deepwater GOM Lower Tertiary play, and Anadarko[875] and other operators had specific experience with these issues, understood the mitigations that could be applied, and had or were developing fields with the same issues and poorer reservoir and fluid properties. [876] Such a situation was still favorable for development and supported the encouraging statement.

951. **Merrill ¶ 96:** "As mentioned above, my report uses the term 'resource' to describe Shen in this case rather than 'reserves' because the Shen wells with oil and natural gas indications were not flow tested and could not be classified as 'proven' oil and gas reserves during the Class Period. Yet at the same UBS Conference, Ms. Szabo implied that there are proven and probable reserves in the Shen field: '[Y]ou can see the number five well up there on that cross-section, so you can see that lighter green color – we're going to be able to turn that dark green. So the lighter green on there is the **probable**, and the darker green is the **proven**, and so we're going to have the ability for that large area over there to go ahead and say, yes, that's **proven**, so that's tremendous

[873] APC-01228875 at slide 9.

[874] APC-00077434 at slide 10.

[875] APC-00044530.

[876] APC-00260481.

for us.' Under the SPE reserves classification, **Proven** (on production – 1P), **Probable** (under development-2P), and **Possible** (planned for development-3P) refer to Discovered Commercial Reserves. On the other hand, resources are referred to as **Contingent Resources**, or Discovered Resources (development-pending, on hold, or not viable), and **Prospective Resources** (undiscovered). The use of **Proven** and **Probable** in the statement suggests that wells have flowed, been tested, and are under development, which overstates the confidence in the resource potential of Shen." (emphasis supplied by Merrill).

952. **Rebuttal to Merrill ¶ 96:** Merrill is incorrect in his statement that "resources" can only be classified as "reserves" if they have been "flow tested." There is no requirement for the hydrocarbons to have been flow tested. However, Merrill is correct in that none of the hydrocarbon at Shenandoah could be classified as "reserves" yet because their commerciality by development had not been approved.

953. The SPE Petroleum Resource Management System defines "Reserves" as:

> "Reserves are those quantities of petroleum anticipated to be commercially recoverable by application of development projects to known accumulations from a given date forward under defined conditions. Reserves must further satisfy four criteria: They must be discovered, recoverable, commercial, and remaining (as of a given date) based on the development project(s) applied." [877]

[877] The Petroleum Resources Management System, 2007, at p. 44.

CONFIDENTIAL

954. The slide Merrill refers to is below.

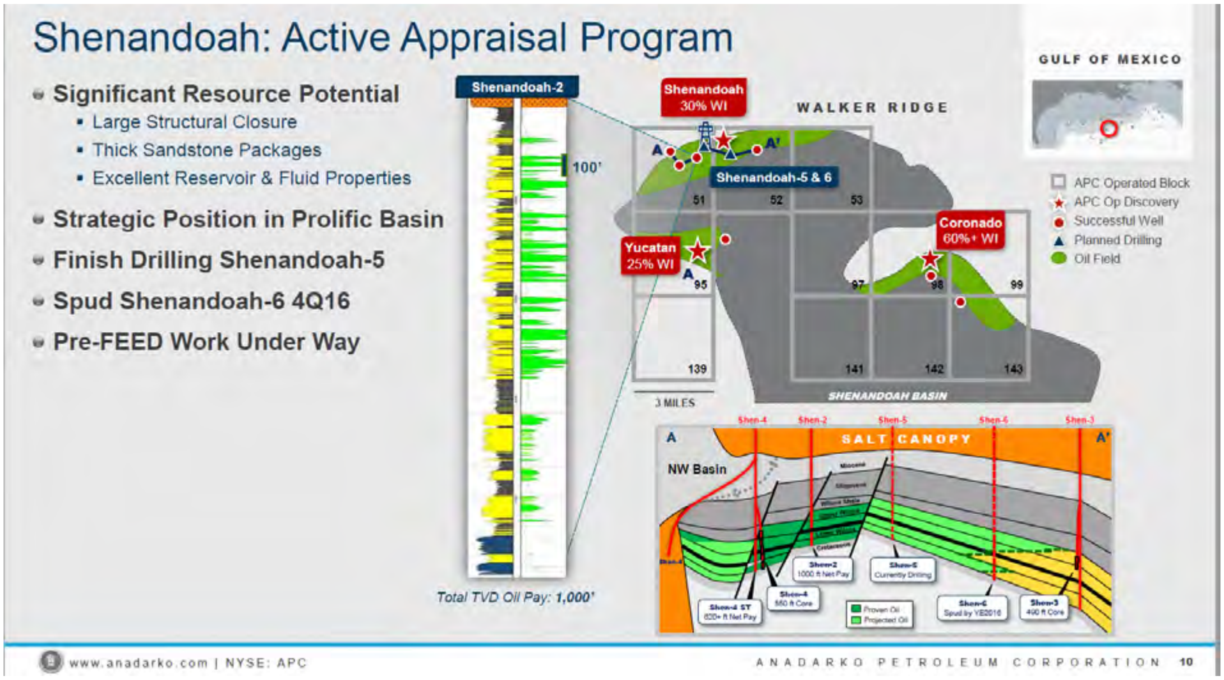


Figure 105 – May 24, 2016 Presentation slide showing status of the Shenandoah appraisal and clearly indicating the fault blocks to investors.[878]

955. Contrary to Merrill's suggestion, the slide does not discuss reserves and Ms. Szabo never uses the word "reserves" during the conference. She only uses the word "resources," and refers to a certain area at Shenandoah being "proven" to contain oil and another area as "probable" to contain oil.[879] Any oil & gas person in the audience would have clearly recognized that Ms. Szabo was not referring to "reserves" in any way given the fact that everyone present knew that FID at Shenandoah had not been reached and that no reserves could have possibly been identified. Merrill's suggestion that just using the words "Proven" and "Probable" in a statement "suggests that wells have flowed, been tested, and are under development" bears no merit.

[878] May 24, 2016 Presentation at UBS Global Oil and Gas Conference at slide 10.

[879] May 24, 2016 Presentation at UBS Global Oil and Gas Conference; May 24, 2016, Transcript of the Anadarko Petroleum Corp at UBS Global Oil and Gas Conference.

956. At the same conference, Ms. Szabo stated: "[W]ith the Shen 6 well, we're targeting trying to find the oil-water contact, and we're pushing that pretty far down the structure. So we had some confidence that we will see the water contact there. That's going to ultimately give us the true resource size."[880] Bob Gwin also stated: "[W]e really don't want to get numbers in people's minds until we know what a development plan actually looks like."[881] These further reinforce that Anadarko lacked sufficient information to sanction the project and book reserves.

5. Rebuttal to Pittinger's Opinions re: Shen-5

957. **Pittinger Opinion re: Shen-5:** Pittinger opines that Shen-5 revealed faulting and tar that doomed Shenandoah's commerciality. He opines that, while Development presented highly optimistic economic estimates, management knew Shenandoah was not commercial.

958. **Rebuttal to Pittinger Opinion re: Shen-5:** Pittinger misrepresents the technical results of the Shen-5 well, and, like Merrill, fails to consider development planning and mitigation strategies designed to address them.[882] He selectively quotes from Anadarko's internal documentation to support his theory that Shenandoah was not commercial, and attributes motivations to management that are not supported by the documents. Rather, the evidence makes clear that the commerciality of Shenandoah relied upon the results of the Shen-6 well.

a. *Rebuttal to "THE IMPACT OF FAULTING: Shen-5 Results"*

959. **Pittinger ¶ 153:** "Results from Shen-5 added weight to the argument for extensive compartmentalization from faulting. Shen-5 pressures were lower than in Shen-1, Shen-2, and She--4ST1, establishing another isolated fault block. . . . A total of 22 ft. of tar was encountered

[880] May 24, 2016, Transcript of the Anadarko Petroleum Corp at UBS Global Oil and Gas Conference, APC-01753704 at p. 11.

[881] *Id.* at p. 12.

[882] APC-00044392 at slide 36.

in the LWC sands, raising doubt about the producibility of the entire LWC zone. The presence of tar also highlighted the risk of having unpredictable tar deposits within the reservoir destroying permeability. . . . The post-Shen-5 resource volumetric estimate decreased to 353 MMBOE, down 17% from the pre-Shen-5 joint model. Combined with the evidence from Shen-4 discussed above, compartmentalization and its negative impact on pressure support, recovery factor, and well count were abundantly evident."

960. **Rebuttal to Pittinger ¶ 153:** Pittinger unfairly characterizes the Shen-5 well as a failure. Anadarko reported favorable news from Shen-5, noting that "AOP's appear to be lower in Shen 5 than in Shen 2; very positive for future production," "Shen 5 fluid mobilities observed to be better," and that "Shen 5 Properties Compare favorably to Shen 2."[883]

961. While the mean resource estimate decreased following Shen-5, Pittinger neglects to note that this decrease was principally due to the up-dip change in the eastern estimated OWC from projections using the Shen-3 well. The lower oil pressures in the Shen-5 well when used to project OWCs with the Shen-3 water pressures implied that the projected eastern OWC would be 200 feet further up-dip[884] than that being used based upon Shen-2 oil pressures.

962. As discussed above in response to Merrill's claims, the tar was not laterally extensive and would have a limited impact on production. Tar, which was only present in some wells, did not "rais[e] doubt about the producibility of the entire LWC zone"[885] or Shenandoah more broadly. Anadarko had experience with tar, including mitigating tar, and sought to understand the range of potential impacts of tar.

[883] APC-00359319 at slides 4, 10, 18.

[884] APC-00359319 at slide 2.

[885] Expert Report of Lyndon Pittinger, ¶ 153.

963. **Pittinger ¶ 155:** "Pressure gradients in Shen-5 displayed in Exhibit 37 show more vertical compartmentalization than previously observed in earlier wells, with ten isolated compartments in this well alone. . . . This intra-sand vertical isolation adds to the fault complexity added by each well, resulting in even smaller compartments. The thinner the flow unit, the easier it can be isolated stratigraphically or by faulting, thereby increasing the likelihood of compartmentalization."

964. **Rebuttal to Pittinger ¶ 155:** As an initial matter, Pittinger's statement that there were "ten isolated compartments" identified in Shen-5 is highly misleading. The graph Pittinger references, reproduced as **Figure 106**, below, documents nine fluid gradients, with only seven of them interpreted as being unique.

CONFIDENTIAL

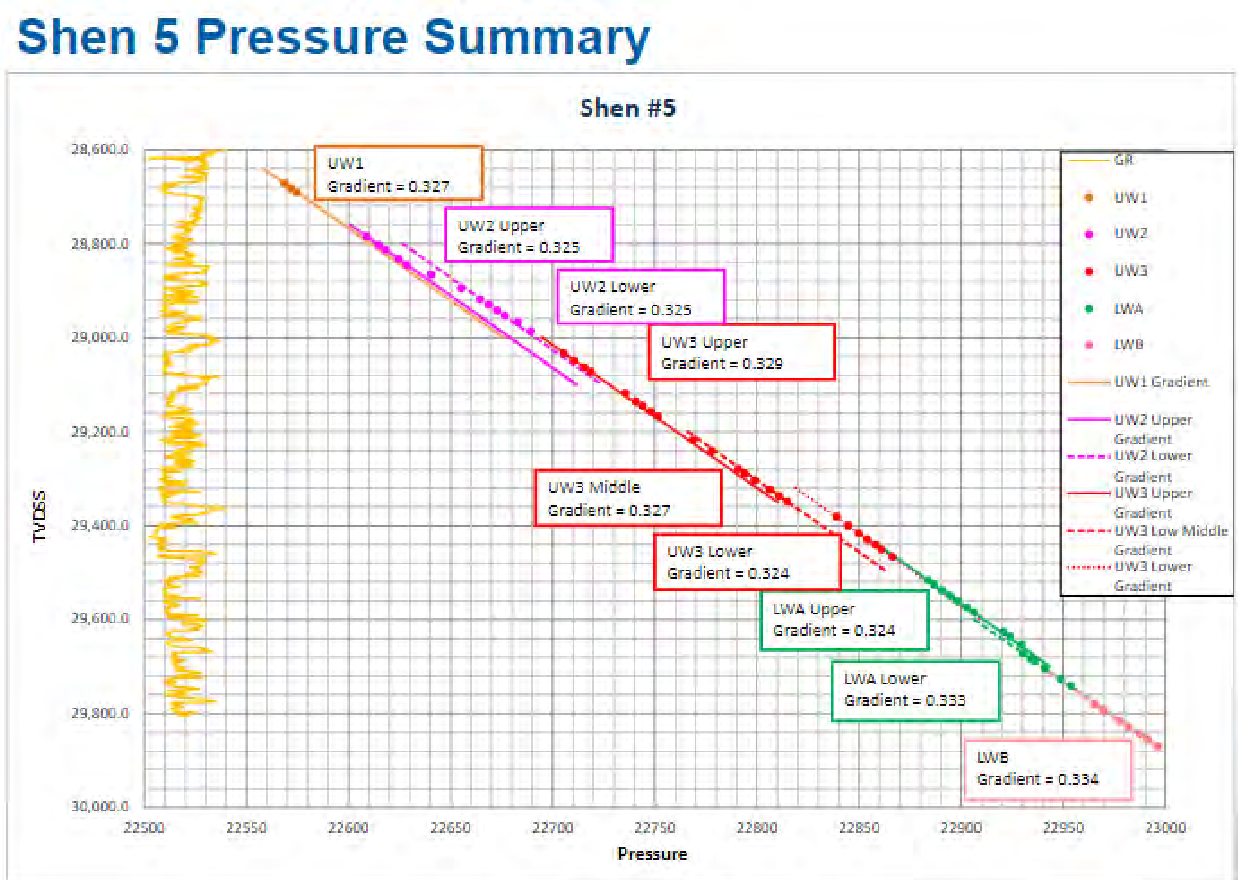


Figure 106 – The Shen-5 Oil Pressures. Unique gradients are measured for 7 zones – (UW1, UW2 upper and lower, UW3 upper, UW3 middle, UW3 lower, UWA upper and lower, and UWB).[886]

965. Based upon this data, the Development team proposed comingling of some zones for production.[887] Comingling is only possible if the zones are near each other, have pressures that are close to each other, and have compatible fluids that can be mixed. Such conditions allow for the different reservoirs to be produced into a single wellbore simultaneously. In addition, it is not uncommon with large columns of oil for there to be a density gradient variation as a function of depth so that small differences as measured over significant depths are actually in fluid contact. This includes in Deepwater Gulf of Mexico fields with similarly large vertical oil columns (*e.g.*,

[886] APC-00359319 at slide 5.

[887] APC-00704565 at -566; APC-00269858 at -858-859.

Mars, Thunderhorse, etc.). Pittinger's assertion that the UW3 sands' "intra-sand vertical isolation adds to the fault complexity added by each well," which would "result[] in even smaller compartments" is possible, but unlikely. In my experience, the more common situation is that under the large pressure differences that production imposes on the field, thin barriers and faulted sand-on-sand contacts begin to break down and these sands eventually function as a single, connected tank.

966. **Pittinger ¶ 157:** "Exhibit 38 from a partner presentation dated September 28, 2016 also showed heavier oil in the Lower Wilcox sands with depth, ranging from 29.3 API in the LWA sand down to 23.7 to 27.5 API in the LWC through E sands. GOR values were also lower in the LWC through LWE sands ranging from 690 to 780 scf/bbl. These lower gravity, lower GOR oils would likely have a substantially lower recovery factor, as demonstrated in a simulation run by Shotts showing recovery efficiency dropped from the base case of 26% to 18% for 28 API oil, resulting in 31% lower oil recovery for the heavier, thicker oil. Therefore, it may not have been cost-effective to develop and might have needed to be excluded from the effective pay count and resource volume."

967. **Rebuttal to Pittinger ¶ 157:** Pittinger quotes adjusted values from this presentation. The summary of values for fluid properties comparing the different Shenandoah wells is included in **Figure 107**, below. This figure shows that the fluid qualities at Shen-5 were not significantly poorer than those measured in other Shenandoah wells.

Fluid Properties Summary

ANADARKO

Sands	Well	Depth	Temperature	Pressure	GOR	API	Viscosity	AOP	SITP
		ft	ºF	psi	(scf/stb)		(cP)	(psi)	psi
UW-1	Shen-5	28,754	183	22,569	1,105	34.1	1.26	12,491	14,613
UW-2	Shen-5	29,024	188	22,673	1,071	34.2	1.15		14,686
UW-3	Shen-5	29,154	190	22,719	1,025	33.6	1.32	12,290	14,656
UW2	Shen-2	29,329	197	22,798	1,119	35.2	0.99	11,799	15,045
UW3-Top	Shen-2	29,576	200	22,906	1,122	35.7	0.89		15,258
LWA-Lwr	Shen-5	29,631	196	22,895	1,100	34.5	1.83	17,983	14,967
UW3-Mid	Shen-2	29,791	202	22,981	1,147	35.5	0.89		15,128
UW3-Bottom	Shen-2	29,907	203	23,024	1,318	33.5	0.88	11,496	15,236
LWA-Upper	Shen-2	30,010	204	23,067	1,151	36.5	0.91		15,283
LWA-Lwr	Shen-5	29,809	199	22,949	953	31.1	1.92	12,716	14,614
LWA-Lwr	Shen-2	30,181	205	23,134	1,210	35.7	0.84	11,908	15,391
LWB	Shen-2	30,323	207	23,185	1,237	35.6	0.90	11,867	15,445
LWC	Shen-2	30,589	210	23,301	1,448	35.4	0.48	11,719	15,753
UW 2	Shen-4	30,604	209	23,220	1,234	37.0	0.74	12,570	15,502
LWD	Shen-2	30,892	212	23,497	1,819	36.6	0.49	13,480	16,156
LWE	Shen-2	31,068	214	23,663	734	24.3	1.20	5,545	14,989
LWC	Shen-4	31,296	217	23,359	1,719	40.6	0.44	14,012	16,572

Figure 107 – Shenandoah Fluid Property Summary tabulated in September 2016 after lab measurement from Shen-5 well.[888]

968. The fluid property values shown above are the flow assurance values that the development moved forward with. Although the differences are generally small, there is a minor trend for the fluid quality to be better as one moves to the west.

969. Pittinger's reliance on Mr. Shotts's reservoir simulation work from two years earlier for the premise that the Lower Wilcox sands "may not have been cost-effective to develop" is both speculative and misplaced. As Pittinger himself points out, the technical analysis on which he bases his conclusion relates to a "simulation run." Specifically, Mr. Shotts's work investigated production performance, as it related to fluid quality assumptions from the worst Shen-1 lower Wilcox "E" sand values.[889] These values are simply not applicable to the Shen-2/Shen-5 area.

[888] APC-00278440 at slide 33.

[889] APC-00137267 at slide 50.

970. Finally, Pittinger's conclusion that whole reservoirs might have "to be excluded from the effective pay count and resource volume" is completely unjustified given the data shown above.

971. **Pittinger ¶ 158:** "Fluid properties varied even between the LWA Upper and LWA Lower sands, indicating intra-zonal compartmentalization. The pervasive presence of fault barriers within the reservoir is the most probable explanation for such wide variations in oil properties, allowing each fault block to have its unique history of oil migration, trapping, and sealing. In addition, tar sands interspersed within the LWC sand raises the risk of intraformational flow barriers caused by highly unpredictable tar accumulations."

972. **Rebuttal to Pittinger ¶ 158:** Fluid variations are likely because of different, complicated migration and residency histories of each reservoir's oil. However, Pittinger's assessment of the impact of a sporadic occurrence of tar within a single reservoir is significantly overstated. As discussed above, patchy tar deposits, coupled with mitigation strategies as have been taken by other operators, were unlikely to have a serious impact on any potential development plan.

b. *Rebuttal to "APPRAISING THE SHENANDOAH RESOURCE – RESOURCE SIZE, QUALITY AND ECONOMICS: Shen-5"*

973. **Pittinger ¶¶ 315-316:** "The economics summary based on this resource assessment is provided in Exhibit 80 below, showing a positive after-tax NPV10 of $175 MM at $50/bbl after a net capital investment of $1,677 MM in the Mid Case. These economics assume no need for injection wells, and pressure support from the aquifer is sufficient to prevent asphaltene deposition. In other words, none of the downside effects of fault compartmentalization and asphaltene deposition were included in the costs, well performance, or recovery, despite the strong evidence to the contrary from Shen-4 and Shen-5. In my expert opinion, these economics represent

a best-case scenario, and more representative economics would most likely have been negative if some of the downsides of compartmentalization and asphaltene deposition were included. . . . Even with optimistic assumptions, the after-tax PIR10 of 0.16 for the Mid Case was well below the Anadarko's threshold of 0.3 at $50/bbl. At $70/bbl the PIR10 was 0.55 but based on highly optimistic assumptions discussed above."

974. **Rebuttal to Pittinger ¶¶ 315-316:** After the success at Shen-5, Pittinger concludes that the project was still uneconomic. Again, Pittinger provides no alternative economic calculation to support his conclusion. He falsely assumes that asphaltene mitigation and interventions are not accounted for by a host of experienced technical staff. He wrongly refers to the team's P50 economics as a "best case scenario" and makes an assumption as to the results of some other, uncompleted "alternative economic calculation." While he continues to criticize the post-Shen-5 economics, he does not recognize that 1) PIR10 during appraisal is used to assess the key drivers for project success and is a "general guideline", and 2) the High Case PIR10 at $50 is PIR10 = 0.4 and a very attractive upside at $70 of PIR = 0.9. This demonstrates the value in continued appraisal.

c. *Rebuttal to "APPRAISING THE SHENANDOAH RESOURCE – RESOURCE SIZE, QUALITY AND ECONOMICS: Post-Shen-5 Economics"*

975. **Pittinger ¶ 317:** "With results from Shen-5, every oil-bearing well in the Shen field proved to be in separate pressure compartments and the recoverable resource estimate continued to diminish."

976. **Rebuttal to Pittinger ¶ 317:** As noted above, pre- and post-Shen-5 estimated volume ranges were determined to have changed minimally, from the pre-Shen-5 P90/mean/P10

of 180/425/690 MMBOE to 134/353/663 following Shen-5.[890] However, there remained a significant portion of the possible recoverable resources lying in the as-yet unproved area to the east of Shen-5 and up-dip of the Shen-3 well. Following Shen-5, the P1 estimates increased from about 1020 to 1220 MMBOE, indicating increased uncertainty on the high-end of the range.[891] Although sand pressures were determined to be different, some of them were still close enough to not vary the development plan adversely.

977. **Pittinger ¶ 318:** "On September 14, 2016, a meeting was held to update the Executive Committee on the results of Shen-5. Although the measured pay totaled an encouraging 1,043 ft. TVT of oil-bearing sands, several findings provided more evidence for compartmentalization as follows:

- 'When adjusted for depth, pressures in the LWA in Shen-5 were substantially lower than in Shen-1, Shen-2, and Shen-4. In other words, the oil zones encountered in all four oil-bearing wells so far are pressure isolated from one another, proving a substantial amount of compartmentalization."
- Pressure trends shifted within the same horizon in the UW2 and UW3, establishing more vertical compartmentalization than observed in previous wells."
- A total of 22 ft. of tar was encountered in the LWC sand, the cause and impact of which is a challenge to explain fully, and oil samples from the Lower Wilcox horizons had heavier oils with API gravities below 30° API. Such variable fluid properties supported a model of a heavily compartmentalized reservoir. The tar and heavier oils were also likely to have an adverse effect on recovery efficiency in the deeper sands.'"

978. **Rebuttal to Pittinger ¶ 318:** The Shen-5 well did not penetrate any recognized faults. Pittinger's total evidence for "compartmentalization" is that the individual sands are pressure separated from each other. But this would be expected in a turbidite sheet layered system

[890] APC-01228541 at slides 73-74.

[891] APC-01228541 at slide 74.

in which each sand has a slightly different OWC. This result would hardly be classified as detrimental "compartmentalization."

979. As Pittinger recognizes, "the cause and impact of [the 22 feet of tar encountered in Shen-5 LWC] is a challenge to explain fully." Pittinger's assumptions that the variable fluid properties "supported a model of a heavily compartmentalized reservoir" and "were also likely to have an adverse effect on recovery efficiency" are not necessarily true. Heavier API oils in the lower Wilcox are likely a result of a seal allowing lighter components to leak off, or of density settling of the oil and the well being near the OWC. The tar is interpreted to be patchy since it has not been seen from well to well or across any common reservoir, and, based upon other Deepwater tar encounters in the Gulf of Mexico, including in the Lower Tertiary, not likely to be widespread or of a significant production problem. Although these fluid quality changes will have some local effect of recovery, given the isolation of the Shen-5 well and the fluid quality in Shen-2 and Shen-4 ST1, they are not likely to have a significant impact.

980. **Pittinger ¶¶ 319–320:** "This presentation also updated the estimated recoverable resource volume. Exhibit 81 below shows a revised estimated mean of 353 MMBOE (untruncated), down 17% from 426 MMBOE for the joint model. Structure maps in Exhibit 81 show the basis for the mapped areas assumed in the calculation. The P90 map is significant because it shows the oil accumulation terminating between Shen-5 and the planned Shen-6 location to the east. The downside area included the risk of faults limiting the eastern extent of the oil accumulation. . . . The primary input parameter causing the reduced volume was the lower P90 area of 748 acres in the post-Shen-5 calculation compared to the P90 sum of 1,989 acres for the west and east blocks assumed in the joint model post-Shen-4."

981. **Rebuttal to Pittinger ¶¶ 319–320:** As Pittinger recognizes, Development included in its P90 map the possibility that there may be minimal to no resources on the eastern side of the field, as this was a significant unknown at this point in time. Pittinger confirms this when he states that the primary cause of the volume reduction was the reduced P90 area. This was the area that the Development team had compromised with Exploration during the RCT; following Shen-5, it chose to eliminate it from the downside estimates. While Pittinger highlights the P90 map, he does not acknowledge that the geologic mean map indicates that the team expected oil accumulation to the east.[892] Anadarko drilled Shen-6 to test this area. The presentation lists the most likely (50% probability) expected outcome of Shen-6 as it being in the same fault block as Shen-5.[893]

982. **Pittinger ¶ 321:** "The risked mean case is the probability-weighted result of the three development scenarios and an appraisal failure scenario with a probability of 19.3% of finding a resource volume below the minimum commercial field size (MCFS) of 175 MMBOE. The resulting rate of return for the risked mean is 15.6% and 11.1% for the P90 case, and the PIR10 values were 0.27 and 0.04 for the risked mean and P90 cases, both below the PIR10 threshold."

983. **Rebuttal to Pittinger ¶ 321:** As an initial matter, a PIR10 of .27 is only minimally below the 0.3 "threshold" and would be unlikely to cause concern. Moreover, Pittinger fails to recognize that these sensitives were based on a $60 price deck, and the same slide notes the risked mean would achieve a modeled PIR10 of 0.3 at $61.75 per barrel—only $1.75 more per barrel than the base case—the P90 at $77.50 per barrel, the P50 at $66.50, and the P10 at $48.25. [894]

---

[892] APC-01228541 at slide 73.

[893] APC-01228541 at slide 80.

[894] APC-01228541 at slide 76,

Pittinger also does not address that these sensitives included certain cost assumptions. At this time, Anadarko was discussing a development solution. The same presentation includes a "Facilities Update," which examines the timeline and costs of various development solutions.[895] It concludes with a recommendation for a semisubmersible concept.[896]

984. Anadarko discussed publicly that it was studying the engineering possibilities for a semisubmersible concept:

> "After completing operations on the Warrior exploration well, the rig is scheduled to drill the Shendandoah-6 appraisal well. This appraisal well is designed to establish the oil-water contact on the eastern flank of the field and further quantify the resource potential." "Anadarko and its partners are continuing to work toward determining the commerciality of the Shenandoah field. The company has chosen a Semisubmersible concept to support the potential development as part of these efforts. The FEED engineering on the Semi will continue, while Anadarko continues appraisal drilling to further delineate the opportunity before making a future sanctioning decision."[897]

985. During an earnings call, Mr. Hollek left no doubt that Anadarko was pursuing a commercial solution for Shenandoah:

> Darrell E. Hollek Former Executive Vice President of Operations: "Okay. Bob, this is Darrell. As you're aware, we were looking at both semisub and spar. We've got both of those in our fleets today, so we're very familiar with both of them. And it just came to a point, rather than spend the time and energy, to do feeds on both of those structures. We saw the flexibility in the semisub not only for taking on what we think we may have there are Shenandoah but understand that we have a lot of prospectivity in the area itself. And so as you look at long term trying to build a hub in the area, we just felt, from a payload standpoint, the semisub gave us a lot more flexibility. So as we move forward here trying to understand our path to sanction, we're just trying to understand is how we would handle the semisub. But we're clearly in the camp that, that's what it'll be if we get to FID."

[895] APC-01228541 at slides 44-58.

[896] APC-01228541 at slide 58.

[897] 10/31/2016 Operations Report at p. 8.

Robert Alan Brackett Sanford C. Bernstein & Co., LLC., Research Division: "If I interpret that a little, a standard 80,000 a day spar wasn't big enough to handle the volumes you expect to come off Shenandoah?"

Darrell E. Hollek Former Executive Vice President of Operations: "Well, I would say it doesn't give us the flexibility for the entire area. We're still learning on Shenandoah itself. So that in itself, we want that flexibility. But when you look at the entire area and the prospectivity in the leases that we actually have today, we want to make sure we have the flexibility to grow that facility if need be."[898]

986. The costs associated with development were a significant unknown at this point in time. Anadarko could not determine an accurate PIR without more complete information on the reservoir qualities and costs.

987. **Pittinger ¶ 322:** "However, these economic cases were again based on a very optimistic assumption of pressure support from a robust aquifer three times larger than the oil accumulation. Flowing pressures must be maintained above a minimum flowing bottomhole pressure of 11,000 psig to mitigate asphaltene deposition in the reservoir. Compartmentalization from east-west trending faults would isolate up-dip producers from the aquifer, requiring an injection well be paired with each producer within compartment boundaries that are not resolvable with the seismic data. No costs for injection wells were included in this version of the economics. Shotts' reservoir modeling work dated August 19, 2014 had already demonstrated the tremendous negative impact of mild east-west faulting, potentially reducing the recovery factor from 26% for an unfaulted case down to only 5% for a case with mild north-south and east-west faulting."

988. **Rebuttal to Pittinger ¶ 322:** Pittinger does not conduct any economic modeling for what he claims are "very optimistic" assumptions. Regardless, Pittinger's criticisms are not correct. First, a three-times aquifer is already somewhat restricted as "large" aquifers are typically ten-times or larger. Second, asphaltene mitigations and intervention plans are already accounted

[898] 2/1/17 Earnings Call at p. 15.

for in Anadarko's development plan. Third, there is no proven need for injection wells. Fourth, there is no indication in the seismic or in the Shen-2, Shen-5, or Shen-3 wells for any significant east-west faulting. Fifth, Shotts's model from two years prior was outdated, as it did not incorporate data from later wells. Regardless, Development used a 13.8% recovery factor, which accounts for sub-seismic faulting consistent with some of Shotts's earlier modeling.

989. **Pittinger ¶ 323:** "At this time, the optimistic assumption of continuity between each producer and the aquifer clashed with key findings from Shen-3, Shen-4, and Shen-5 regarding the prevalence of compartmentalization. An east-west fault through the base of Shen-3 was included in structure maps as early as May 13, 2015. Shen-4BP1 was drilled 300-400 ft. from Shen-4ST1, yet was missing three zones and had 24% (153 ft.) less net oil pay than encountered in the sidetrack. The two wellbores were in separate pressure compartments, demonstrating complex compartmentalization on a very small scale."

990. **Rebuttal to Pittinger ¶ 323:** The east-west fault placed on development's map at the base of the Shen-3 well was not verified by seismic identification and does not appear on partner maps. The faults at Shen-4 ST1 are not mapped as east-west faults and are in a near-salt structural area that is not duplicated in the Shen-2 to Shen-5 area. Pittinger attempts to manufacture evidence of significant east-west faulting in the central Shen-2 and Shen-5 area where most of the developable resources have been identified. However, there is no direct evidence to support his claim.

991. **Pittinger ¶ 324:** "With results from Shen-5, every oil-bearing well in the Shen field proved to be in separate pressure compartments. Sands within the same zone even showed vertical pressure compartmentalization from each other. The 22 ft. of tar-bearing sands in the Shen-5 LWC zone and lower API oils in the well in the Lower Wilcox sands further demonstrated

compartmentalization allowing fluid properties to vary laterally and vertically. Given the strength of this evidence for compartmentalization on an alarmingly small scale, the assumption that aquifer support would be sufficient in both the P90 and P50 scenarios to avoid asphaltene dropout and provide high recovery factors was inexplicably optimistic, in my expert opinion."

992. **Rebuttal to Pittinger ¶ 324:** Pittinger continues to argue that undetectable small-scale faulting makes the Shenandoah field undevelopable. Pittinger's references to Shen-5, Shen-2, and Shen-4 ST1 oil columns being separate does not directly relate to fault separation from the aquifer. Vertical separation between sands is neither unexpected nor related to any separation from the downdip aquifer. Neither of these arguments demonstrate isolation of up-dip oil from its downdip aquifer. Further, Pittinger's concerns of asphaltene dropout are also unfounded. The development plan has accounted for each of these factors and for "small-scale" unrecognized issues by reducing the recovery factor from ~30% to 13.8%. Pittinger's arguments demonstrate lack of recognition of the integrated technical work that experienced professionals at Anadarko and their partners had already done.

993. Pittinger also fails to recognize Anadarko's efforts to bring the project to sanction. The September 2016 Shenandoah EC Update presentation includes the following slides:

CONFIDENTIAL

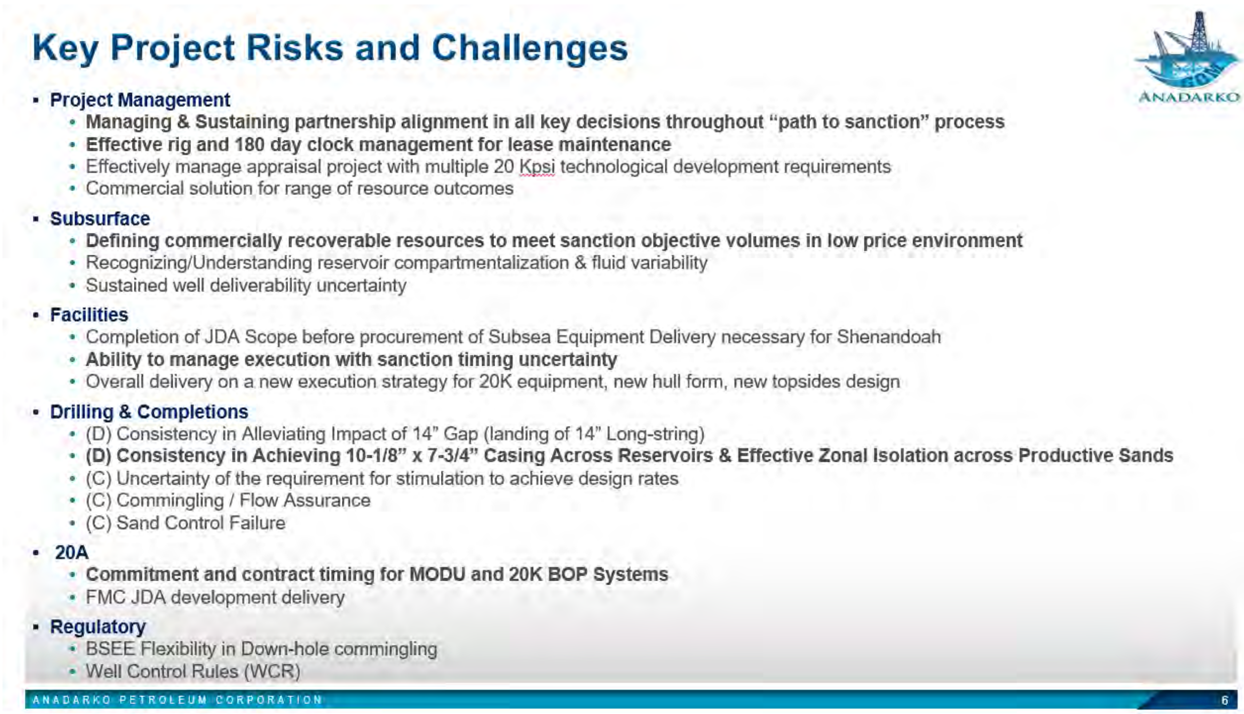


Figure 108 – September 2016 slide demonstrating planned development activities and progress for Shenandoah field.[899]

[899] APC-01228541 at slide 6.

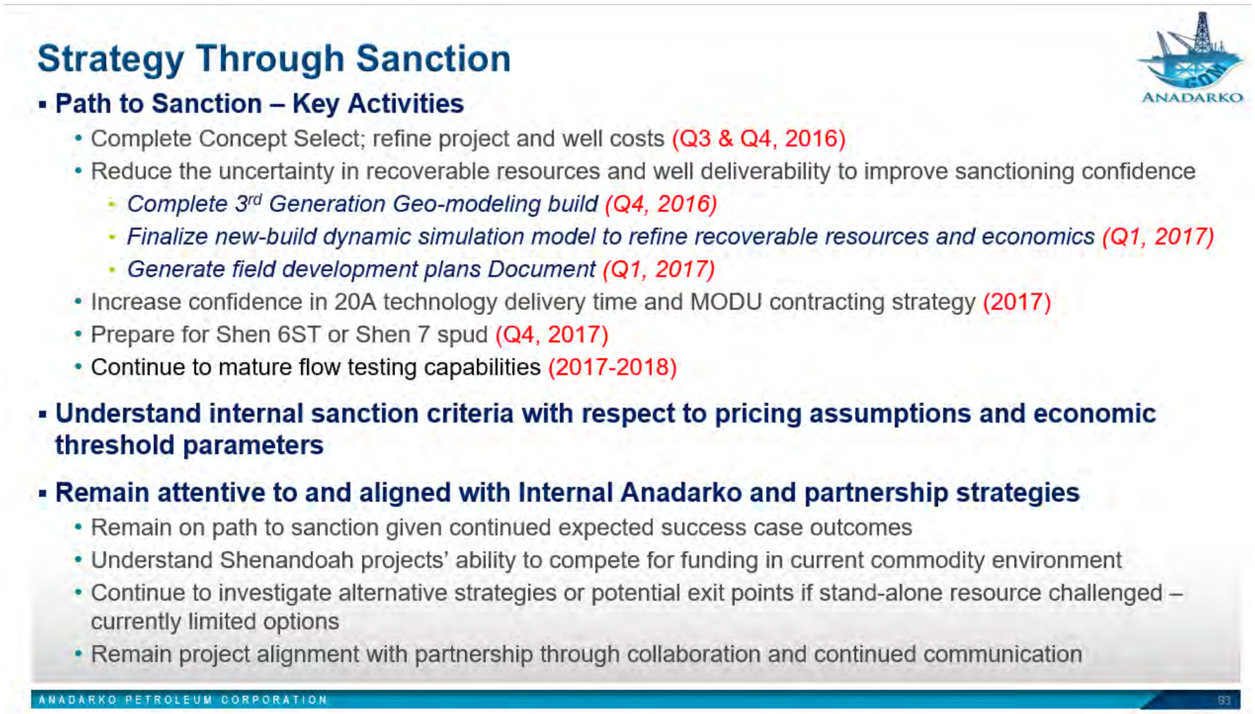


Figure 109 – September 2016 slide illustrating Anadarko's continued efforts for reaching sanction for Shenandoah field development.[900]

994. While Pittinger claims that Anadarko's economics were overly optimistic, he fails to consider that Anadarko recognized certain risks, both as to the reservoir uncertainty and business concerns, and sought to design a development plan that accounted for those risks.

G. Shen-6

1. Well Results

995. The Shen-6 appraisal well - also referred to as "WR 52 #3" - was spud on December 15, 2016 and was intended to establish the oil-water contacts in the eastern portion of the field.[901] The well finished drilling on February 8, 2017 and did not encounter any oil, condemning most of the far eastern area.[902]

---

900 APC-01228541 at slide 93.

901 APC-00312102; APC-00299898 at p. 1.

902 APC-00299898 at p. 1

996. In response, Anadarko commenced a sidetrack operation ("Shen-6 Sidetrack", or "Shen-6 ST") to drill to the west and up-dip of Shen-6 to prove the OWC in the Shen-5 fault block.[903] Shen-6 ST was commenced on February 18, 2017, and drilling and evaluation was completed on April 18, 2017, but it also did not encounter any oil.[904] Shen-6 ST and a mechanically induced associated bypass operation also encountered evidence of faulting to the west of Shen-6, implying that the fault block containing the oil encountered in Shen-5 was likely smaller than originally thought, and confirming that a fault or faults separated Shen-5 from Shen-6.[905]

997. Shen-6 and Shen-6 Sidetrack encountered water-filled sands above the OWC estimated for Shen-5 and that were in pressure agreement with the water-filled sands at Shen-3. This clearly indicated that a fault must exist between Shen-5 and Shen-6, and that Shen-6 and Shen-3 are in pressure communication in the aquifer.

998. The Shen-6 series of wellbores resulted in a further downward revision of estimated recoverable volumes, with Anadarko having an updated mean estimate of 220 MMBOE[906] and ConocoPhillips having a mean estimate of 245 MMBOE.[907]

999. Up until this point, Anadarko's Development team had focused on development options that required developable volumes that were larger than were now likely. The notes of the April 4, 2017 presentation entitled "Shenandoah Project Update & Path Forward Executive Committee Review" note, "**The Results of the Shen 6 well have materially changed the economics for a stand-alone facility to the point** (at current market pricing) where it is no longer

[903] *Id.*

[904] APC-00091554.

[905] APC-01282251 at slides 12-19.

[906] APC-01288761 at slide 1.

[907] ANACOP00008900 at slide 5.

a viable stand-alone option without the help of basin exploration success."[908] This therefore required a significant reassessment of engineering options to identify the best Development plan for the field. However, the clock on "continuous operations" caused by the Walker Ridge lease expirations was still running, and Anadarko was under pressure to decide the best path forward quickly. The same presentation noted, "We have reached the point of diminishing returns where additional appraisal drilling at Shenandoah will not materially move the needle. We believe that it makes sense to get off of the clock and put the capital to work in the basin exploration program to supplement resources and achieve a critical mass for a Shenandoah hub. Merit to Stop the clock and slow down the spending."[909] The presentation lists three options – follow the status quo, reduce pace and preserve optionality, or exit the basin. Anadarko Development recommended reducing pace and spending but *not* exiting the basin, as they had "the building blocks with a major discovery and multiple exploration prospects that can add significant long term value for the basin."[910]

1000. Anadarko investigated a number of development options, including a co-development study with Chevron's Anchor project[911] and a Titan Spar Relocation.[912] However, by August 2017, a Gunnison Spar Relocation emerged as the leading development option with positive economics[913] and it remained their leading development path forward until the partnership withdrawals.

---

[908] APC-00091671 at slide 1.

[909] *Id.*

[910] *Id.* at slide 3.

[911] APC-00100713.

[912] APC-00327052.

[913] APC-00327862.

1001. In September, Anadarko unsuccessfully sought to farm out some of its interest to Statoil. Since Anadarko was unprepared to submit a Development plan to the BOEM after the Shen-6 results and the partnership was on a 365-day clock for "continuous operations" to maintain the Unit leases, Anadarko proposed drilling another Shenandoah appraisal/development well, referred to as "Shen-7." (In June 2017 the BOEM extended the amount of time a lessee or operator is given to resume operations or to seek a suspension of operations (SOO) or suspension of production (SOP) to retain an offshore oil and gas lease beyond the primary lease term from 180 days to 365 days.)[914]

1002. On November 9, 2017, Anadarko submitted the AFE for Shen-7 to partners.[915] On December 6, 2017, ConocoPhillips non-consented to the well but indicated their preference to remain in the partnership until Shen-7 was actually spud.[916] On December 12, 2017, Anadarko wrote a letter indicating that ConocoPhillips' election not to participate in the Shen-7 AFE constituted a withdrawal from the partnership,[917] and joined them in their withdrawal, thus removing the drilling of Shen-7 as an option to hold the Unit. Then, on December 19, 2017, ConocoPhillips issued a formal notice to withdraw from the partnership.[918] With ConocoPhillips' and Anadarko's withdrawal, their interests would have to be taken up in an agreeable fashion by the remaining partners. However, on December 17, 2017, Cobalt filed for bankruptcy, and its interests were auctioned off in March 2018.

---

[914] VanNess Feldman LLP, *BSEE Issues Rule Extending Development Time for Offshore Oil and Gas Leaseholders*, June 16, 2017, https://www.vnf.com/bsee-issues-rule-extending-development-time-for-offshore.

[915] ANACOP00001816-817.

[916] ANACOP00008866-67.

[917] APC-00754345.

[918] APC-00755040.

1003. Cobalt's interest was sold at bankruptcy auction on March 7, 2018 to Navitas Petroleum. Navitas then brought in LLOG Exploration, who became the operator of the Shenandoah development. Affiliates of LLOG, Navitas Petroleum, and Beacon Offshore, agreed to acquire 70% working interest in the project in April 2018. In 2018 interests were split as follows: LLOG(operator)/Beacon/Navitas 70% and Venari 30%. LLOG then filed a Suspension of Production ("SOP") with BOEM/BSEE in April 2018.[919] Beacon Offshore subsequently assumed operatorship by acquiring LLOG's 31% stake in the Shenandoah project in 2020. Finally, on August 25th, 2021, HEQ Deepwater, Houston, acquired a 20% working interest from Beacon.

1004. In February 2021, Beacon filed a development plan with the BOEM[920] and in August 2021 publicly announced sanctioning of the $1.8bn offshore subsea development project.[921] Currently, Beacon holds 20.05% interest with BOE II Exploration holding 10.95%, Navitas at 49%, and HEQ Deepwater at 20%.

2. Structure Mapping

1005. Because Shen-6 and Shen-6 sidetrack encountered water-filled sands above the OWC estimated for Shen-5 and because they were in pressure agreement with the water-filled sands at Shen-3, this clearly indicated that a fault must exist between Shen-5 and Shen-6. As depicted in the below Figure, this also indicated that Shen-6 and Shen-3 were in pressure communication within the aquifer. It is important to note that despite all partners' best efforts, the sealing fault between Shen-5 and Shen-6 had not been mapped or anticipated.[922]

---

[919] APC-01314375 at slide 72.

[920] *Studies Development Plan 2021-2022*, Bureau of Ocean Energy Management (February 2021).

[921] NS Energy Newsletter, "Shenandoah Field Development."

[922] *See* APC-01228541 at slide 80 (showing no interpreted fault separation between Shen-5 and the proposed Shen-6 location).

CONFIDENTIAL

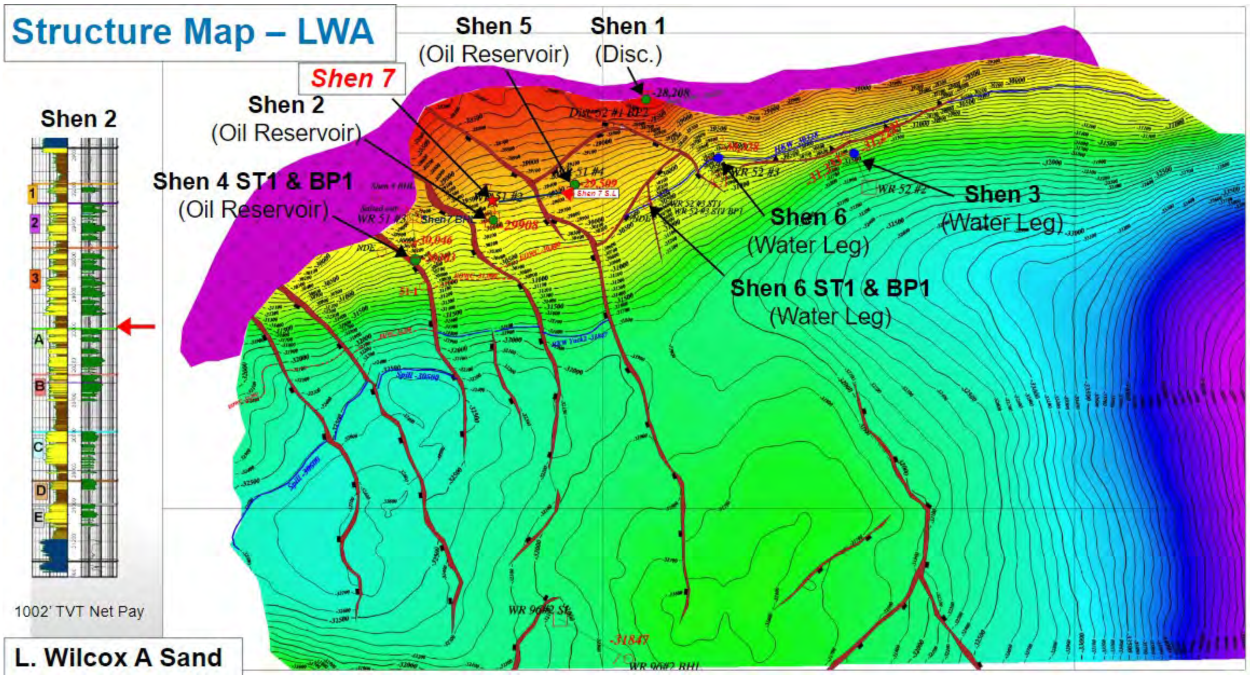


Figure 110 – Post Shen-6 structure map (October 2017) from Anadarko Development with a newly interpreted fault separating Shen-5 from Shen-6. This fault had been unrecognized by the partnership in their pre-Shen-6 maps.[923]

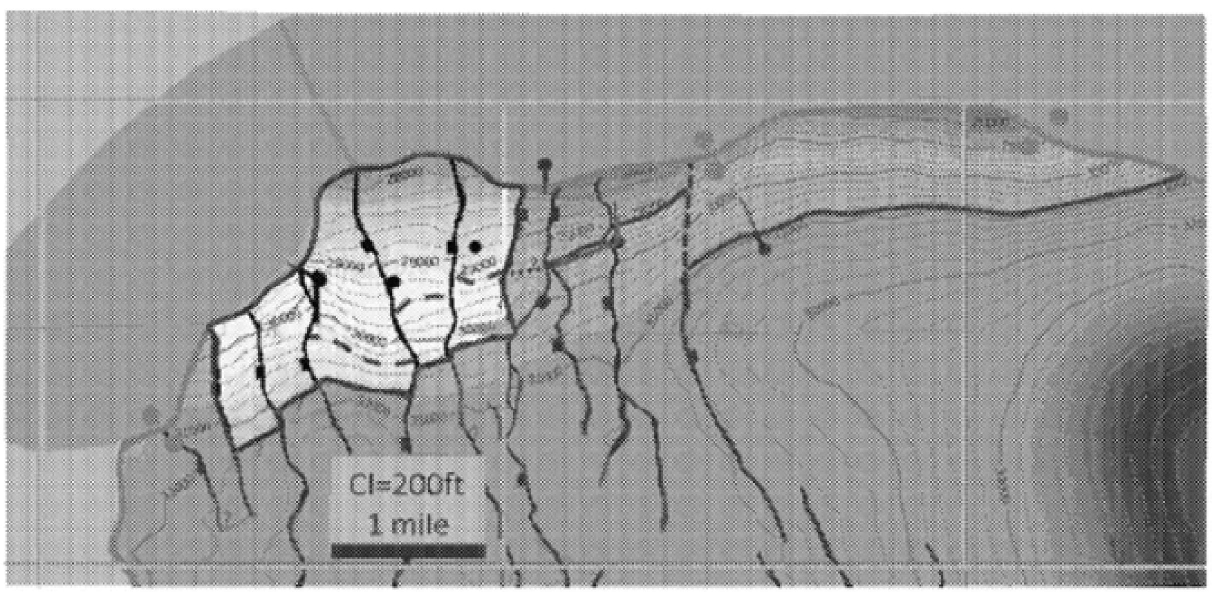


Figure 111 – ConocoPhillips' post Shen-6 structure map (October 2017) also indicating additional faulting with developable volumes limited to the Shen-2, Shen-5, and Shen-4 fault blocks.[924]

[923] APC-01288612 at slide 3.

[924] ANACOP00008087 at -179.

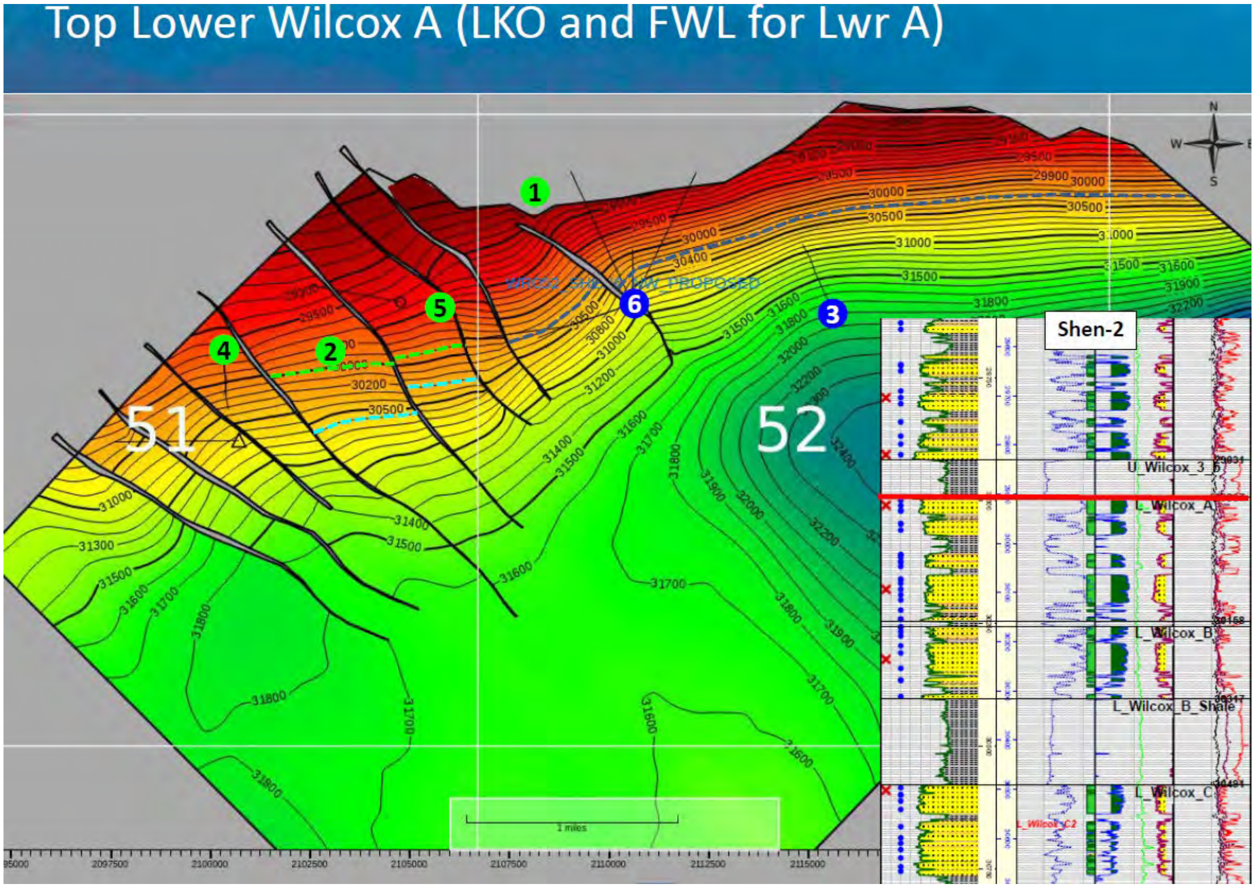
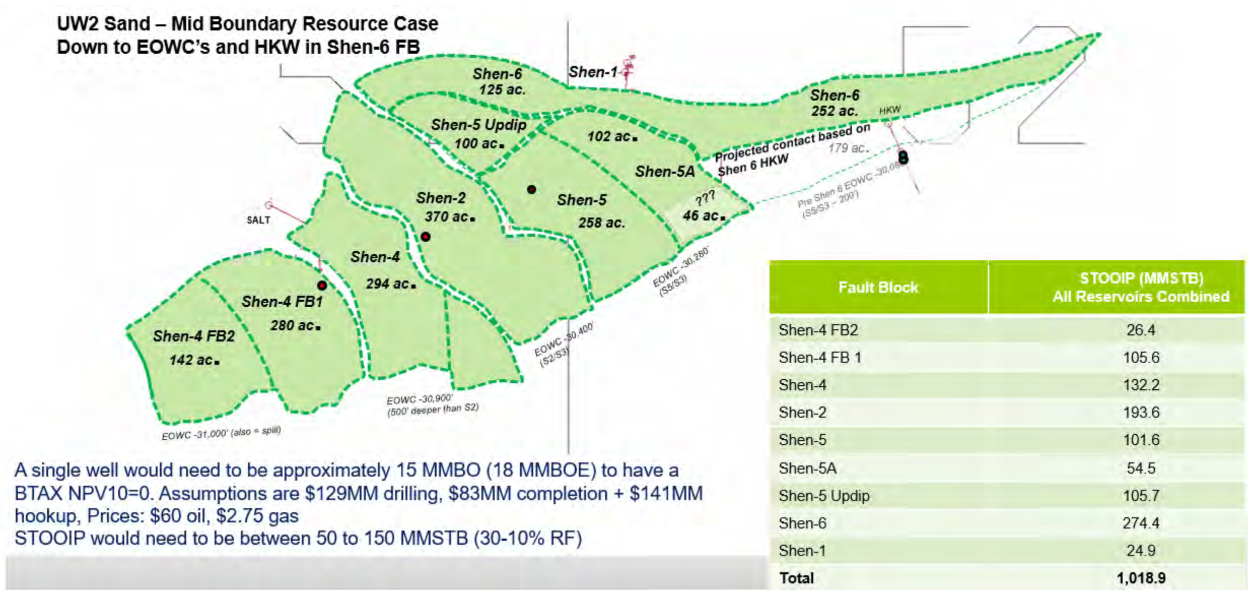


Figure 112 – Venari Post Shen-6 structure map (July 2017) also indicating additional faulting between the Shen-5 and Shen-6 wells. The projected OWCs for fault blocks Shen-2 and Shen-5 (light blue) are estimated by projecting from Shen-6/Shen-3 water pressures.[925]

1006. The Shen-6 well was drilled east of Shen-5 and up-dip of Shen-3 with the intention of penetrating OWCs, and was also designed with the ability to be sidetracked up-dip and be kept as a producing well. However, neither Shen-6 nor its sidetrack encountered oil. Further, Shen-6 encountered water with different pressures than those measured at Shen-5. This result implied that: (1) a sealing fault must separate the oil reservoirs in Shen-5 from wet reservoirs in Shen-6, (2) any remaining oil in the Shen-6 fault block must be further up-dip and would be too small of an accumulation to pursue, and (3) Highest Known Water from Shen-6 projected east implied any eastern fault blocks were likely to only have small accumulations of oil.

[925] APC-00100772 at slide 4.

CONFIDENTIAL



Fault Block	STOOIP (MMSTB) All Reservoirs Combined
Shen-4 FB2	26.4
Shen-4 FB 1	105.6
Shen-4	132.2
Shen-2	193.6
Shen-5	101.6
Shen-5A	54.5
Shen-5 Updip	105.7
Shen-6	274.4
Shen-1	24.9
Total	1,018.9

Figure 113 – Anadarko Development map after Shen-6 indicating updated OWCs. The wet Shen-6 and sidetrack indicated that Shen-5 and Shen-6 were not connected in the oil column. Note that all estimated OWCs from Shen-4 ST1 to the east are calculated using water pressures from Shen-3 [926]

1007. After the Shen-6 well, which found only the aquifer, the Shen-3 aquifer pressures were still considered valid for projecting the OWCs of the Shen-2 and Shen-5 fault blocks.[927]

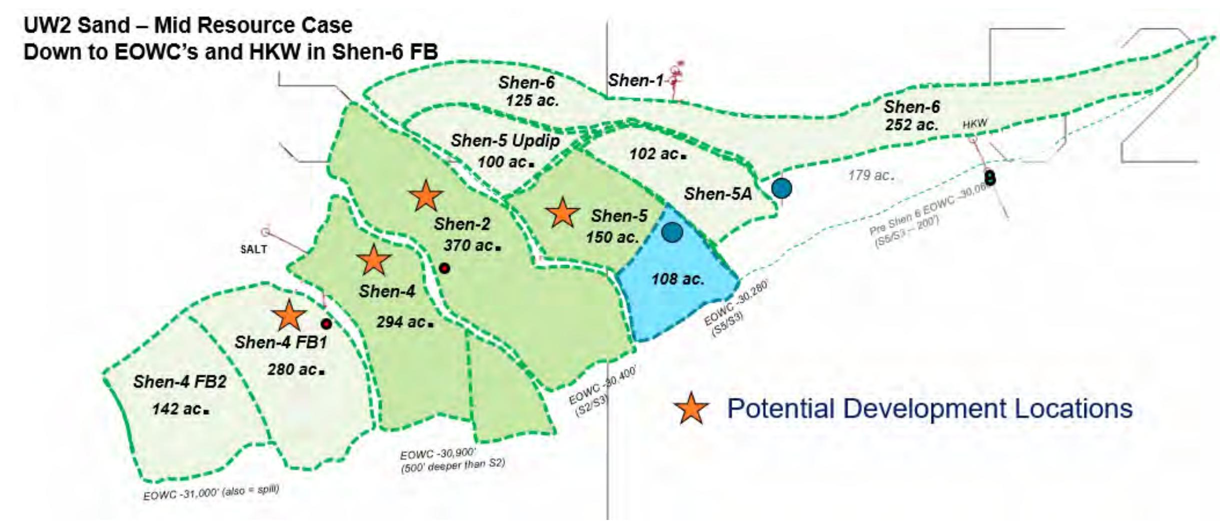


Figure 114 – Anadarko Development map after Shen-6 well indicating producible compartments and potential development well locations. Faults define oil compartments that are expected to

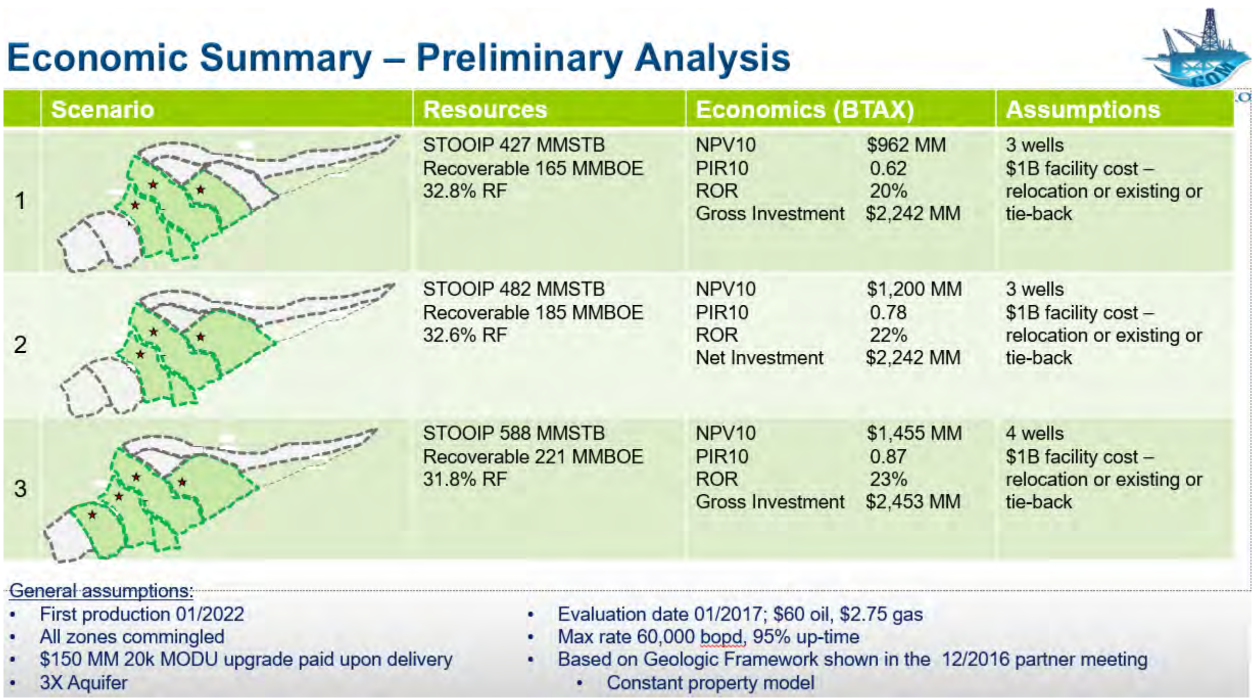
[926] APC-01264361 at slide 20.

[927] APC-01314375 at slide 57.

CONFIDENTIAL

produce differently. However, estimated OWCs are still calculated under the interpretation of a common downdip aquifer in pressure communication with Shen-3 well.[928]

1008. The Shen-6 results left the partnership with proven developable accumulations of oil in the fault blocks containing Shen-4 ST1, Shen-2, and Shen-5 only, with possible future oil accumulations west of Shen-4 ST1.[929] In each of these three developable fault blocks, OWCs consisted of: 1) an up-dip proven OWC from LKO determined from that fault block's well, 2) a mid-dip projected OWC using that fault block's oil pressures and the Shen-6/Shen-3 water pressures, and 3) a downdip maximum fill OWC from HKW based upon the Shen-6 well.



Economic Summary – Preliminary Analysis

	Scenario	Resources	Economics (BTAX)		Assumptions
1		STOOIP 427 MMSTB Recoverable 165 MMBOE 32.8% RF	NPV10 PIR10 ROR Gross Investment	$962 MM 0.62 20% $2,242 MM	3 wells $1B facility cost – relocation or existing or tie-back
2		STOOIP 482 MMSTB Recoverable 185 MMBOE 32.6% RF	NPV10 PIR10 ROR Net Investment	$1,200 MM 0.78 22% $2,242 MM	3 wells $1B facility cost – relocation or existing or tie-back
3		STOOIP 588 MMSTB Recoverable 221 MMBOE 31.8% RF	NPV10 PIR10 ROR Gross Investment	$1,455 MM 0.87 23% $2,453 MM	4 wells $1B facility cost – relocation or existing or tie-back

General assumptions:
- First production 01/2022
- All zones commingled
- $150 MM 20k MODU upgrade paid upon delivery
- 3X Aquifer
- Evaluation date 01/2017; $60 oil, $2.75 gas
- Max rate 60,000 bopd, 95% up-time
- Based on Geologic Framework shown in the 12/2016 partner meeting
  - Constant property model

Figure 115 – Anadarko Development remaining developable fault blocks post-Shen-6 appraisal with remaining uncertainly on the location of OWCs for each fault block.[930]

[928] *Id.*

[929] APC-01264361 at slide 22.

[930] *Id.*

3. Rebuttal to Merrill Opinions re: Shen-6:

1009. **Merrill Opinion re: Shen-6:** Merrill focuses on the results of the reprocessed seismic, which he recognizes gave Anadarko additional information about the reservoir. Merrill nonetheless opines that Anadarko abandoned Shenandoah as non-commercial.

1010. **Rebuttal to Merrill Opinion re: Shen-6:** Although Merrill largely accurately describes the results of the Shen-6 well, he ignores their significance on the results of the appraisal process. As Merrill recognizes, the 2016 reprocessed seismic gave Anadarko's appraisal team additional information about the extent of faulting. This information, in addition to the results of the Shen-5 well, caused Anadarko to reconsider its path forward. Importantly, Merrill ignores that Anadarko did not abandon Shenandoah, but rather, they considered additional development options moving forward. Moreover, as discussed below, Merrill later disclaimed this opinion during his deposition.[931]

1011. **Merrill ¶ 93:** "Shen-6 followed Shen-5 and encountered no hydrocarbons; it was a wet well; the sidetrack targeting OWC's downdip from Shen-5 was wet and in a different fault block from Shen-5. The highest known water in the Lower Wilcox E was at -31,31954 ft subsea, and the eastern OWC was raised to -30,400 ft based on pressure data. With the drilling of Shen-5 and Shen-6, it was clear that each fault compartment had separate OWC's for each of the Wilcox zones (Figure 30). Following Shen-6, Anadarko recognized several remaining uncertainties. The location of the salt weld and the trap affected the structure's northern and western edges. Additionally, there was still some uncertainty in the OWC and how Shen-1 fit into the structural picture."

[931] Merrill Dep. Tr. 76:14-76:19

1012. **Rebuttal to Merrill ¶ 93:** Merrill chronicles the events of the Shen-6 wells relatively accurately but does not appreciate the significance of this part of the appraisal. Although Shen-6 was disappointing, it reduced the uncertainty in the field to a point where an appropriate development plan could likely be made. As Merrill recognizes, the improved seismic helped Anadarko better understand certain areas of the reservoir. However, there remained uncertainty near the central and near western fault blocks. The uncertainty in those blocks' OWCs could ultimately be addressed by field production as the producing wells would be drilled up-dip near Shen-4 and Shen-2, and Shen-5 could be used as a producer. As shown in **Figure 110**, the Anadarko Development team's map after Shen-6 indicated producible compartments and potential development well locations. Limiting the development to the areas shaded in darker green eliminates most of the important remaining uncertainties important to its development plan.[932]

1013. **Merrill ¶ 94:** "The 2016 reprocessed seismic solved the Shen-1 structural issue, indicating it was a rafted or trapped sedimentary block with the trap for the Shen-1 sands being the updip weld . . . . It also clearly defined the faults that had been the focus of the exploration team/development team disagreement . . . . Wireline logs, including OBMI, indications of fractures, faults, and deformation bands in cores, and seismic confirm the field's faults and potential flow barriers, compartmentalizing the field and significantly reducing the resource potential from the original exploration team estimates. However, a map in a March 2016 presentation, 'Shenandoah: An Appraisal Update' . . . , indicated a likely reverse fault just north of Shen-3. With Anadarko's focus on compartmentalization in the western part of the structure and the Shen-3 dry hole, the Easternmost fault block still showed no faults. Anadarko wrote off the Shen field in its entirety after the close of the market on May 2, 2017."

[932] APC-01314375 at slide 57.

1014. **Rebuttal to Merrill ¶ 94:** Although Merrill claims that the 2016 version of seismic data "clearly defined the faults that had been the focus of the exploration team/development team disagreement," that version of the seismic still does not clearly define most faults and did not identify the sealing fault between Shen-5 and Shen-6 before the drilling of Shen-6. Merrill simultaneously appears to suggest that this improved seismic data, which resulted in the removal of the east-west reverse fault previously put on earlier development maps, was ignored, resulting in no faulting on the easternmost fault block. But Merrill has not inspected any of the seismic datasets and has no basis for making a judgment on the quality of the seismic data.

1015. While Merrill argues that "[w]ireline logs, including OBMI, indications of fractures, faults, and deformation bands in cores, and seismic confirm the field's faults and potential flow barriers, compartmentalizing the field and significantly reducing the resource potential from the original exploration team estimates," the resource reduction from exploration's original estimates was principally due to large areas of the structure either not existing (up-dip of Shen-4) or not bearing hydrocarbons (easternmost area).

1016. **Merrill ¶¶ 24, 97:** "Anadarko abandoned the Shen project in 2017 as non-commercial after presenting its discovery as one of the most significant discoveries in the Gulf of Mexico."

1017. **Rebuttal to Merrill ¶¶ 24, 97:** Merrill walked this statement back during his deposition, saying he could not "speculate as to why [Anadarko] exited" the appraisal project.[933] Regardless, this statement in his report is factually incorrect. Based upon its column height and rock and fluid properties in an emerging Lower Tertiary play, the Shenandoah discovery was one of the most significant discoveries in the Gulf of Mexico. The significance of a discovery has very

[933] Merrill Dep. Tr. 76:14 -76:19.

little to do with its commerciality. Wells can be geologically successful without being economically successful, such as the BAHA well that opened the Lower Tertiary play but was never able to be commercialized.

Anadarko did not "abandon[] the Shen project" or determine that it was "non-commercial." As late as September 2017, Anadarko was looking for ways to raise capital to take the project forward for development.[934] After May 2017, the company actively pursued redeploying the Gunnison Spar to Shenandoah as a development option, actively pursued raising capital and securing Statoil as a replacement partner for Marathon,[935] and proposed the drilling of Shen-7.[936] Anadarko did not give up its leases until 2018, when the time to preserve their leases was expiring and ConocoPhillips' non-consent on Shen-7 placed the company into a capital constraint situation. Other companies are commercializing the field today with an economic development plan filed with the BOEM, further indicating its commerciality.

4. Rebuttal to Pittinger Opinions re: Shen-6:

1018. **Pittinger Opinion re: Shen-6:** Pittinger opines that "the Shen appraisal project failed due to complex fault compartmentalization and Anadarko Exploration avoided and censored reasonable discussion of faulting and its impact."

1019. **Rebuttal to Pittinger Opinion re: Shen-6:** Pittinger's claim that Shenandoah Exploration censored discussion of faulting is not supported by the record. Moreover, Pittinger fails to explain how this alleged censorship impacted Anadarko's actions from January 2016

[934] APC-00748692-93.

[935] APC-00748692-93.

[936] APC-00336945.

onwards, when Development took over the project. While Pittinger, like Merrill, claims that Anadarko abandoned Shenandoah as non-commercial, this is not supported by the record.

a. *Rebuttal to "THE IMPACT OF FAULTING: Shen-6 Results"*

1020. **Pittinger ¶ 161:** "The following seismic section in Exhibit 39 shows the extraordinary evolution of recognizing the presence of faults (black lines) since the August 18, 2014 mandate that no faults were to be mapped."

1021. **Rebuttal to Pittinger ¶ 161:** Pittinger's reference to an "August 18, 2014 mandate" is incorrect as there is no evidence indicating such a "mandate" was ever issued. In addition, many of the faults on the seismic section that Pittinger references do not have any strong evidence for their existence but are simply an interpretation. Just as with each interpretation by the Development team prior to this well, it is likely that at least some of these faults will need to be removed or moved.

1022. **Pittinger ¶ 162:** "Twelve days after the well was reported as wet internally, Anadarko submitted its 2016 10-K form on February 17, 2017. The statement announces at page 11: 'The Shenandoah_6 appraisal well was spud in the fourth quarter of 2016. The drilling objective is to establish the oil-water contact on the eastern flank of the field and to help quantify the resource potential of the basin.' At the time of this submission, Anadarko unambiguously knew the well was wet, which severely negatively impacted the economic viability of the entire Shen project."

1023. **Rebuttal to Pittinger ¶ 162:** While Pittinger focuses on Shen-6 being wet, at the time it submitted its 2016 10-K on February 17, 2017, Shen-6 operations were still underway.

Anadarko had not completed its analysis of the Shen-6 results, and had plans to drill the Shen-6 ST.[937] The results of the sidetrack were vital to determining the path forward.[938]

1024. **Pittinger ¶ 163:** "An accounting document dated March 27, 2017 provides a summary shown below of two sidetrack attempts. The first sidetrack tested a location thought to be down-dip but in the same fault block as Shen-5. Finding the UW2 wet and in a separate pressure compartment as Shen-5 was a significant adverse finding, proving fault complexity on a very small scale that was not detectable within the resolution of the seismic data."

1025. **Rebuttal to Pittinger ¶ 163:** Pittinger's conclusion that Shen-6 ST's result proved "fault complexity on a very small scale that was not detectable within the resolution of the seismic data" seems to imply that faults not on a "very small scale" could be detected on the seismic data. However, this is also not true. The seismic could not be used to detect many faults at Shenandoah, on even a reasonably large scale. The Shen-6 ST demonstrated that one cannot confidently map faults from this quality of seismic, consistent with the Anadarko Exploration team's claim throughout the appraisal period. In fact, one can estimate the resolution of this seismic data since the smallest wavelengths apparent in the subsalt sediment section appear to be approximately 800 feet, and the best resolution that one might hope for would be approximately one quarter of this wavelength, or approximately 200 feet. Consequently, no fault or feature that is 200 feet or smaller is likely to be detectable on this seismic data. In my expert opinion, a fault with 200 feet of throw could hardly be classified as a "very small scale."

1026. **Pittinger ¶ 164:** "A presentation dated March 1, 2017 on Shen development options concluded: 'Spar relocation is currently the only commercially viable solution for

[937] APC-00089435.

[938] APC-00299520.

Shenandoah.' The SPAR available for relocation was the Heidelberg SPAR, which was underperforming at the time. Such a serious conclusion regarding the only viable solution demonstrates the importance of the negative results from the Shen-6 well."

1027. **Rebuttal to Pittinger ¶ 164:** At the time of this presentation, the Shen-6 ST was being drilled. This presentation is important because it clearly demonstrated a "commercially viable" development for Shenandoah, even under Pittinger's theory, as the calculated economics for this development plan had a PIR of 0.3.[939] Unfortunately, it involved reaching agreement with both the Shenandoah partners and the Heidelberg partners, and doing so within the time frame allowed by the BOEM.[940] As Pittinger recognizes, the "negative results from the Shen-6 well" limited the development options. The aforementioned presentation confirms this: "Recent appraisal results indicate new-build stand-alone solutions are challenged[.] Current concept select development (100M BOPD semi) no longer commercially viable[.] Smaller development (60M BOPD semi) economically challenged in currently depressed commodity market."[941]

1028. **Pittinger ¶ 165:** "On April 26, 2017, Leyendecker emailed a draft announcement that Anadarko would suspend appraisal activities on the Shen field."

1029. **Rebuttal to Pittinger ¶ 165:** Pittinger erroneously references document APC-00073642 dated 4/26/17, but that document is an email exchange with Mr. McGrievy closing out the invoicing for their Geomechanics study. To the extent Pittinger is referring to communications with the partners regarding Anadarko's proposed statement about suspending operations, it is important to note that other members of the partnership pushed back against Anadarko's statement

[939] APC-00090245 at slide 5.

[940] APC-00090245 at slide 10.

[941] APC-00090245 at slide 2.

that they would "suspend" operations and instead wanted to state that the company had "completed its appraisal drilling program" and was "evaluating well results to properly determine the optimal development path forward for the field," indicating the partners' continued interest in developing the field.[942]

1030. **Pittinger ¶ 166:** "In my expert opinion, the Shen appraisal project failed due to complex fault compartmentalization and Anadarko Exploration avoided and censored reasonable discussion of faulting and its impact."

1031. **Rebuttal to Pittinger ¶ 166:** Pittinger characterizes the appraisal project as "failed" when it accomplished what an appraisal project is supposed to do—arrive at a narrow enough estimate of recoverable resources and their economic viability to decide upon the proper path forward. Characterizing an appraisal as "failed" because the resource was smaller than one would have preferred is not the way the oil and gas business works. A "failed appraisal" would be one that led to an FID for an investment that subsequently did not deliver on what was promised. That does not describe Shenandoah.

1032. Pittinger's blaming of "complex fault compartmentalization" as a reason for the "failure" is also incorrect. Any faulting or complex compartmentalization that is present at Shenandoah is a result of the natural state of the reservoir; one can only fail at recognizing it before making a FID. Likewise, blaming the challenging economics on "Anadarko Exploration avoid[ing] and censor[ing] reasonable discussion of faulting and its impact" is also incorrect. Exploration's approach of only recognizing "proven" faults is a chosen strategy which was no more right or wrong than development's strategy of recognizing faults that did not exist. This is not only unsupported by the record, but it is in conflict with Pittinger's own theory, as the Development

[942] APC-00094684-85.

team took control of the project in approximately January 2016—before the drilling of Shen-5 and Shen-6. Pittinger does not explain how Exploration's mapping—a significant portion of which occurred before the start of the Class Period—impacted the eventual decision to suspend appraisal activities and explore an alternative solution for the project.

b. *Rebuttal to "APPRAISING THE SHENANDOAH RESOURCE – RESOURCE SIZE, QUALITY AND ECONOMICS: Post-Shen-6"*

1033. **Pittinger ¶ 325:** "Shen-6 was yet another unsuccessful well. The findings from Shen 6 were a cascade of negative information regarding the small scale of the compartmentalization from faults beyond the seismic data resolution. The original hole was wet and proved pressure isolated with Shen 5. Then, the sidetrack was targeted down-dip of Shen 5 but was wet."

1034. **Rebuttal to Pittinger ¶ 325:** Although the Shen-6 appraisal was "wet", Pittinger is in error in defining it as an "unsuccessful well." Shen-6 was a successful appraisal of the area east of the Shen-5 well, definitively eliminating an area that had previously defined a large uncertainty associated with the P10 and P50 volume estimates. "Successful appraisals" are those that reduce uncertainty and lead to a decision.

1035. **Pittinger ¶ 327:** "The target of the Shen-6ST1 was the southern part of what was thought to be the Shen-5 oil-bearing block. Instead, the Shen-6ST1 wellbore penetrated wet sands in the UW2 formation before drilling problems proving the Shen-5 fault block was smaller than mapped. In the bypass core, the UW1 and UW2 were wet. Drilling operations ceased after running into problems with tar and lost circulation in the UW3 formation, proving again that faulting and compartmentalization were much more complex than mapped. The presence of tar also proved that asphaltene deposition had already occurred historically within the reservoir."

1036. **Rebuttal to Pittinger ¶ 327:** Pittinger's interpretation that "[t]he presence of tar also proved that asphaltene deposition had already occurred historically within the reservoir" is not correct in that the presence of tar is usually related to the lighter hydrocarbon elements having been removed due to "water-washing" or from density separation, not from "asphaltene deposition." Asphaltene deposition requires a lowering of reservoir pressure below AOP and/or a lower of temperature, which raises the AOP. Neither of these conditions occur in Shenandoah's virgin reservoir where both pressure and temperature are well above this onset, and have been since the basin was charged.

1037. **Pittinger ¶ 328:** "On May 2, 2017, defendants filed the 1Q2017 10-Q, disclosing that Anadarko had '*suspended further appraisal activities' (emphasis added)* on the Shen project and had taken a $467 MM impairment for the purchase price of the leases and a $435 MM charge for previously capitalized expenses."

1038. **Rebuttal to Pittinger ¶ 328:** As noted above, when Anadarko was planning to announce that it would suspend operations, the partners pushed back against the wording, emphasizing their desire to consider development solutions.[943] Then, in June 2017, ConocoPhillips, Cobalt, and Venari sent Pat McGrievy a letter saying they believed that Shenandoah was potentially still "economically attractive."

> "Cobalt International Energy, L.P. ('Cobalt'), ConocoPhillips Company (''COPC'), and Venari Offshore, LLC, have expressed concern over Anadarko's recent public statement of its intent to suspend further operations towards development of our Shenandoah. Prospect ('Shenandoah'), and that it cannot support the filing of a Suspension of Production ('SOP') committing to first production.
>
> Cobalt, COPC, and Venari (collectively the 'Non-Operators'), are disappointed that Anadarko unilaterally made this decision without engaging us. We see Anadarko's action as potentially putting our interests and investment in Shenandoah at great

943 APC-00094684-85.

> risk, It is our hope that, going forward, Anadarko will work cooperatively with the Non-Operators to identify and evaluate all options that could present an avenue for economic development of Shenandoah to the benefit of all parties."[944]

1039. In concluding that Shenandoah was not commercially viable, Pittinger fails to acknowledge or explain the partners' continued desire to develop the project. He also ignores relevant evidence of what is currently happening at Shenandoah because he did not believe public reporting regarding Shenandoah's productive resource size. When asked during his deposition if he was familiar with what is currently happening at Shenandoah, Pittinger explained that it was outside the scope of his report. He testified that he did not "think there's enough coverage to develop an understanding of what's going on there," because he found only one article listing reserves "and they list a very strange number that's hard to understand," so he "figure[d] that that one has got to be a mistake."[945]

H. Rebuttal to Plaintiffs' Experts' Conclusions

1. Rebuttal to Merrill's Conclusions

1040. **Merrill ¶ 97:** "Known risks and uncertainties about Shen leading up to and during the Class Period contradicted Anadarko's rosy public statements, including significant evidence of compartmentalization and faulting, a shrinking resource, and other key risks. Exploration mapping of Shen with no faults and vigorous dissent from the pre-development team were red flags for management."

1041. **Rebuttal to Merrill ¶ 97:** Notwithstanding this statement in his report, Merrill admits that Anadarko's public statements about the existence of faulting were "beyond the scope

---

[944] APC-00739429.

[945] Pittinger Dep. Tr. 289:4-291:1.

of [his] report."[946] He confirmed that his opinion that the "overly simplistic portrayal of the resource was used to make overly optimistic statements about the resource range and the oil-water contacts" related only to internal statements.[947] When asked about the statement in his report that "Anadarko continued to use resource estimate results in their public statements attributed to a single map," Merrill confirmed he was referencing the "~$2 - $4 billion opportunity" statement.[948] The only public statement beyond the $2 to $4 billion opportunity statement that Merrill cites is Ms. Szabo's statement. As explained above, Merrill overstates Ms. Szabo's statement—she never referred to reserves and it was clear that the field was not under development.

2. Rebuttal to Pittinger's Conclusion

1042. **Pittinger ¶ 329:** "Based on my review of the technical work and the evidence as detailed above, I conclude that Anadarko personnel and management knew that Shen was probably commercially unviable following Shen-3 and unviable with reasonable certainty after Shen-4 due to extensive fault compartmentalization and asphaltene deposition."

1043. **Rebuttal to Pittinger ¶ 329:** While Pittinger criticizes the quality of technical work performed by Anadarko's technical staff, he has never shown that any Anadarko staff or their partners, ConocoPhillips, Cobalt and Venari, ever believed that the project would be "commercially unviable" at any time before or during the Class Period. Pittinger's assumptions of the impact of "unseen" faulting on the project is overreaching, and his conclusions based upon asphaltenes in the oil are unfounded and were not shared by Anadarko or its partners.

[946] Merrill Dep Tr. 78:20-25.

[947] Expert Report of Robert Merrill, ¶ 46; Merrill Dep Tr. 130:17-25.

[948] Merrill Dep Tr. 172:16-172:21.

1044. While Pittinger focuses on Shen-3 and Shen-4, it is the Shen-6 results in 2017 that caused a clear shift in Anadarko's view of the appraisal project and how to proceed. Even after the disappointment of Shen-6, Anadarko's partners still felt that the project was "economically viable", and the actions taken since then by others to commercialize the Shenandoah field has proved Pittinger wrong in his assessment.

VII. CONCLUSION

1045. In conclusion my findings and opinions with respect to this matter are as follows:

1046. The depositional environment at Shenandoah consisted of remarkable quality sands that trapped a thick stack of high quality oils in a deepwater subsalt basin, which made it a promising opportunity in an emerging high-pressure deepwater Gulf of Mexico play.

1047. The combination of poor subsalt seismic imaging and sparse appraisal well information led to significant uncertainty regarding the Shenandoah field subsurface structure, including the location and extent of faulting. However, as a result of additional appraisal drilling and seismic reprocessing during the Class Period, there came to be relative consensus both within Anadarko and among the partnership that north-south faulting divided the field into oil-separated fault blocks. The possibility of small-scale faulting impacting hydrocarbon recovery is still unknown, but was accounted for by Anadarko and the other partners by predicting lower recovery factors than a laterally connected reservoir would deliver.

1048. Plaintiffs' experts are overly critical of the quality of technical work performed by Anadarko's Exploration and Development staff, but the evidence supports the conclusion that these staff worked with technical skill and integrity. They engaged regularly with their technical counterparts at their partner companies and arrived at comparable interpretations that were plausible and consistent with available data. Plaintiffs' experts provide no alternative evaluations or calculations based upon their own analysis of the data, and fail to explain why partner evaluations also supported continued appraisal and eventual development.

1049. Plaintiffs' experts' opinions that the field was likely non-commercial following Shen-3 and non-commercial after Shen-4 are unsupported by the evidence and by the expert opinions of the technical staff and management at Anadarko and its partners, ConocoPhillips, Cobalt, Marathon, and Venari, all of whom supported continued investment in Shenandoah.

1050. Plaintiffs' experts overstate the negative implications of certain risks, such as asphaltenes and faulting. Even after the appraisal was complete, ConocoPhillips, Cobalt, and Venari continued to argue for a commercial development plan. As of the date of this report, Navitas and Beacon have filed such a plan and are actively developing the Shenandoah field. Since it is fair to assume that the subsurface characteristics of the field have remained fundamentally unchanged from when Anadarko appraised it, the current development plans are compelling evidence that Shenandoah was commercially viable during the Class Period as well.

1051. Finally, based on my review of the public statements in the Amended Complaint, Anadarko made accurate statements about Shenandoah. The alleged omissions that Plaintiffs identify are either commonly known uncertainties, such as the risk of faulting, or technical details, which in my experience are not publicly disclosed. Plaintiffs' experts, while mentioning Anadarko's "public statements" in their report, have not demonstrated that any statements were misleading.

This Report executed by Dr. Rocco Detomo, Jr. on January 25, 2023.

Rocco Detomo Jr.

Dr. Rocco Detomo, Jr.

APPENDIX 1 – DOCUMENTS AND INFORMATION CONSIDERED IN MY REPORT

Case Materials
Expert Report of Lyndon Pittinger and Associated Materials, November 9, 2022
Expert Report of Robert Merrill and Associated Materials, November 9, 2022
Amended Complaint and Associated Materials, August 17, 2020
Declaration of Christopher Camden on Behalf of Defendants, January 23, 2023
Deposition of Carlotta Chernoff and Exhibits, June 16, 2022
Deposition of Charles F. Oudin and Exhibits, June 30, 2022
Deposition of Chris Camden and Exhibits, July 14, 2022
Deposition of Darrel Hollek and Exhibits, September 1, 2022
Deposition of David Blakely and Exhibits, August 19, 2022
Deposition of Doug Shotts and Exhibits, June 29, 2022
Deposition of Ernest A Leyendecker and Exhibits, September 22, 2022
Deposition of James Kleckner and Exhibits, October 14, 2022
Deposition of Jonathan M. Ramsey and Exhibits, August 4, 2022
Deposition of Lea Frye and Exhibits, October 13, 2022
Deposition of Lyndon Pittinger and Exhibits, December 16, 2022
Deposition of Matt Morris and Exhibits, June 9, 2022
Deposition of Patrick McGrievy and Exhibits, August 24, 2022
Deposition of Paul Chandler and Exhibits, July 28, 2022
Deposition of Robert A Walker and Exhibits, October 20, 2022
Deposition of Robert Daniels and Exhibits, October 7, 2022
Deposition of Robert G. Gwin and Exhibits, October 26, 2022
Deposition of Robert Merrill and Exhibits, December 7, 2022
Deposition of Robert Strickling and Exhibits, July 21, 2022
Deposition of Shandell Marie Szabo and Exhibits, October 28, 2022
Stamped Materials
ANACOP00000001
ANACOP00000137
ANACOP00000558
ANACOP00000890
ANACOP00001027
ANACOP00001136
ANACOP00001279
ANACOP00001816
ANACOP00003083

ANACOP00005209
ANACOP00005640
ANACOP00006293
ANACOP00006964
ANACOP00007385
ANACOP00007468
ANACOP00008087
ANACOP00008866
ANACOP00008900
ANACOP00009201
ANACOP00009398
ANACOP00009420
ANACOP00014518
ANACOP00020939
ANACOP00024675
ANACOP00024798
ANACOP00024814
ANACOP00025504
APC-00000646
APC-00000671
APC-00000907
APC-00000959
APC-00000996
APC-00001020
APC-00001023
APC-00001024
APC-00001026
APC-00001048
APC-00001085
APC-00001146
APC-00001289
APC-00001448
APC-00001466
APC-00001505
APC-00001791
APC-00001914
APC-00001935

APC-00001962
APC-00001974
APC-00002093
APC-00002094
APC-00002151
APC-00002161
APC-00002201
APC-00002203
APC-00002204
APC-00002305
APC-00002831
APC-00003046
APC-00003724
APC-00004880
APC-00004964
APC-00004967
APC-00004970
APC-00005092
APC-00007619
APC-00010161
APC-00011004
APC-00011019
APC-00013451
APC-00014422
APC-00015676
APC-00016723
APC-00016754
APC-00016936
APC-00018078
APC-00020023
APC-00020506
APC-00022625
APC-00029360
APC-00044392
APC-00044530
APC-00045640
APC-00045971

APC-00049176
APC-00053661
APC-00057599
APC-00057872
APC-00058253
APC-00058398
APC-00059161
APC-00059196
APC-00059276
APC-00059603
APC-00060671
APC-00063752
APC-00065685
APC-00066032
APC-00066042
APC-00067336
APC-00070330
APC-00077434
APC-00081279
APC-00081302
APC-00082675
APC-00083873
APC-00084788
APC-00089435
APC-00090245
APC-00091554
APC-00091671
APC-00094684
APC-00100713
APC-00100772
APC-00117310
APC-00117313
APC-00117318
APC-00117345
APC-00129805
APC-00129874
APC-00132687

APC-00135061
APC-00137267
APC-00147455
APC-00147547
APC-00147987
APC-00147996
APC-00148076
APC-00148608
APC-00153588
APC-00153668
APC-00157431
APC-00165815
APC-00169083
APC-00171344
APC-00172770
APC-00188661
APC-00191621
APC-00193551
APC-00196222
APC-00196456
APC-00209545
APC-00214510
APC-00214592
APC-00216034
APC-00219133
APC-00221988
APC-00225661
APC-00222712
APC-00223098
APC-00233134
APC-00256036
APC-00257632
APC-00259884
APC-00260481
APC-00263016
APC-00267881
APC-00269858

APC-00278440
APC-00285180
APC-00299520
APC-00299898
APC-00307805
APC-00312102
APC-00327052
APC-00327862
APC-00336945
APC-00348941
APC-00356191
APC-00358150
APC-00359319
APC-00573912
APC-00577352
APC-00584245
APC-00584341
APC-00584359
APC-00585873
APC-00590469
APC-00593836
APC-00594667
APC-00605965
APC-00617121
APC-00617135
APC-00617218
APC-00617367
APC-00617479
APC-00617571
APC-00617572
APC-00618050
APC-00618490
APC-00633951
APC-00642417
APC-00646864
APC-00648353
APC-00653389

CONFIDENTIAL

APC-00659407
APC-00660240
APC-00663563
APC-00663564
APC-00665185
APC-00667721
APC-00668987
APC-00675736
APC-00704016
APC-00704565
APC-00705528
APC-00739429
APC-00748692
APC-00754345
APC-00754867
APC-00755040
APC-00784657
APC-00830435
APC-00852342
APC-00852630
APC-00865047
APC-01006408
APC-01006587
APC-01160608
APC-01166104
APC-01166304
APC-01167170
APC-01180900
APC-01193461
APC-01204634
APC-01228478
APC-01228541
APC-01228875
APC-01229585
APC-01229949
APC-01235401
APC-01264361

CONFIDENTIAL

APC-01282251
APC-01286239
APC-01288068
APC-01288467
APC-01288612
APC-01288761
APC-01314375
APC-01335462
APC-01350202
APC-01351563
APC-01362172
APC-01362523
APC-01363508
APC-01413136
APC-01446937
APC-01669692
APC-01669695
APC-01671424
APC-01672140
APC-01674681
APC-01678462
APC-01681245
APC-01702198
APC-01730272
APC-01737814
APC-01737817
APC-01740518
APC-01740527
Marathon_000001
Marathon_000411
Marathon_001698
Marathon_002602
Marathon_003142
Marathon_003170
Marathon_003362
Marathon_003646
Marathon_003734

Marathon_004756
Marathon_004816
Marathon_004825
Marathon_004981
Marathon_006167
Marathon_011477
Marathon_012009
Marathon_012605
Marathon_013736
Marathon_014240
Marathon_014286
Marathon_014652
Marathon_014658
Marathon_014736
Marathon_014843
Public Transcripts and Presentations
"Anadarko Announces Shenandoah Appraisal Well Encounters More Than 1,000 Net Feet Of Oil Pay," Anadarko Press Release, March 19, 2013 (APC-00572655).
Anadarko Petroleum Corporation, Investor Conference Transcript, March 13, 2012 (APC-01753516).
Anadarko Petroleum Corporation, Q4 2014 Earnings Call Transcript, February 3, 2015 (APC-01751500).
Anadarko Petroleum Corporation, Q4 2015 Earnings Call Transcript, February 2, 2016 (APC-01751417).
Anadarko Petroleum Corporation, Q4 2016 Earnings Call Transcript, February 1, 2017 (APC-01751627).
Anadarko Petroleum Corporation, Third-Quarter 2015 Operations Report, October 27, 2015 (APC-01751361).
Anadarko Petroleum Corporation, Third-Quarter Operations Report, October 31, 2016 (APC-01751393).
Anadarko Petroleum Corporation, UBS Global Oil & Gas Conference Presentation, May 24, 2016 (APC-01753735).
Anadarko Petroleum Corporation, UBS Global Oil & Gas Conference Transcript, May 24, 2016 (APC-01753704).
Colglazier, John, "Sustained Growth With Unmatched Optionality," 2014 Anadarko Investor Conference Presentation, March 4, 2014 (APC-01753996).
ConocoPhillips, Q3 2015 Earnings Call Transcript, October 29, 2015.

Daniels, Bob, "Delivering Differentiating Value" Anadarko Investor Conference," March 13, 2012 (APC-01751308).
-
Cramez, Carlos "Turbidite Deposits: Mutti's Model," September 2014, http://homepage.ufp.pt/biblioteca/Turbidite%20Depositional%20Systems/Pages/Page13.htm
Cramez, Carlos "Turbidite Deposits: Turbidite Facies & Related Processes," September 2014, http://homepage.ufp.pt/biblioteca/Turbidite%20Depositional%20Systems/Pages/Page7.htm.
Cunha, J.C. et al., "Challenges on Drilling and Completion Operations of Deep Wells in Ultra-Deepwater Zones in the Gulf of Mexico," SPE Annual Technical Conference and Exhibition (SPE-125111-MS), October 2009.
Dikkers, A.J., "Appraisal Drilling,“ Chapter G in Developments in Petroleum Science, Vol. 20, 1985.
Dumont, Hadrien et al., "Asphaltene Onset Pressure Uncertainty and Other Asphaltene Issues in Field Development Planning," Offshore Technology Conference (OTC 27826-MS), May 2017.
Glantz, Morton, and Robert Kissell, "A Primer on Risk Mathematics," Chapter 2 in Multi-Asset Risk Modeling, Academic Press, 2014.
Han, Gang et al., "Deepwater Bitumen Drilling: What Happened Downhole?" IADC/SPE Drilling Conference (IADC/SPE 111600), March 2008.
Islam, Rafiqul M. and M. Enamul Hossain, "State-of-the-art of Drilling," Chapter 2 in Drilling Engineering: Towards Achieving Total Sustainability, 2020, p. 168.
Lim, Frank H., Eulalia Munoz ,and Nikhil B. Joshi "Design and Initial Results of EOR and Flow Assurance Lab Tests for K2 Field Development in the Deepwater Gulf of Mexico," Offshore Technology Conference (OTC-19624-MS), May 2008.
Montesi, Alberto et al., "Asphaltene Management in GOM DW Subsea Development," Offshore Technology Conference (OTC-21587-MS), May 2011.
Mutti, Emiliano, Daniel Bernoulli, Franco Ricci Lucchi, and Roberto Tinterri, "Turbidites and Turbidity Currents from Alpine 'Flysch' to the Exploration of Continental Margins," Sedimentology, Vol. 56, 2009.
Niculescu, Bogdan-Mihai and Constantin-Laurian Ciuperca, "Identification of Fluid Contacts by using Formation Pressure Data and Geophysical Well Logs," 9th International Multidisciplinary Scientific GeoConference SGEM 2019, Vol. 19, No. 1.2, July 2019.
Reineck, Hans-Erich and Indra Bir Singh, "Depositional Environments," Chapter 1 in Depositional Sedimentary Environments, Springer (2nd ed. 1980)

Ring, Jasper N. et al., "Management of Typhoon: A Subsea, Deepwater Development," SPE Annual Technical Conference and Exhibition (SPE-84147-MS), October 2003.
Shanmugam, G. "Glossary: A supplement to 'Submarine fans: A critical retrospective (1950-2015),'" Journal of Palaeogeography, Vol. 5, No. 3, 2016.
Snedden, John W. et al., "Reservoir Connectivity: Definitions, Examples, and Strategies" International Petroleum Technology Conference (IPTC 11375), December 2007.
Weatherl, M.H., "Encountering an Unexpected Tar Formation in a Deepwater Gulf of Mexico Exploration Well," SPE/IADC Drilling Conference (SPE-105619-MS), February 2007.
Williams, Jeffrey H., "Continuum Forces," Chapter 8 in Dimension Analysis: The Great Principle of Similitude, IOP Publishing, 2021.
Academic Literature
"Deepwater Gulf of Mexico," BOEM 2021-005, Bureau of Ocean Energy Management, December 31, 2019.
"Estimated Oil and Gas Reserves Gulf of Mexico OCS Region," BOEM 2020-028, Bureau of Ocean Energy Management, December 31, 2018.
"Petroleum Resources Management System," Society of Petroleum Engineers, 2007.
"Petroleum Resources Management System," Society of Petroleum Engineers, June 2018 (v. 103).
"Studies Development Plan 2021-2022," Bureau of Ocean Energy Management, February 2021.
Anadarko 2009-2011, 2014, 2017-2018 10-K Filings.
Beacon Offshore Energy, Shenandoah Development Plan, BOEM 2-2021, Bureau of Ocean Energy Management.
Beacon Offshore Energy, Supplemental Development Operations Coordination Document, March 14, 2022.
Navitas Petroleum Annual Report 2021
Navitas Petroleum Limited Partnership, Final Investment Decision (FID) for the Shenandoah Project Development (August 26, 2021).
Omoted Training Compilation – 2018.
RoseRA Quick Start Handbook v1.1.20201111, Lognormal Solution, Rose & Associates, November 2020
Internet Materials
"Anadarko Announces Another Deepwater Gulf of Mexico Discovery," Anadarko Press Release, February 4, 2009

CONFIDENTIAL

"Anadarko Announces Gulf of Mexico Discovery," Anadarko Press Release, December 4, 2007
"Anadarko Announces Its Fourth Deepwater Gulf of Mexico Discovery in 2009," EuroPetrole, August 2, 2009, https://www.euro-petrole.com/anadarko-announces-its-fourth-deepwater-gulf-of-mexico-discovery-in-2009-n-i-3497
"Anadarko Makes Deepwater Discovery with Genghis Khan Well," Rigzone, April 27, 2005, https://www.rigzone.com/news/oil_gas/a/22105/anadarko_makes_deepwater_discovery_with_genghis_khan_well/
"Anadarko Makes Deepwater Gulf Find at Mission Deep," Oil & Gas Journal, December 11, 2006, https://www.ogj.com/exploration-development/article/17281208/anadarko-makes-deepwater-gulf-find-at-mission-deep
"Anadarko Makes Discovery in Gulf of Mexico," Houston Business Journal, November 17, 2003, https://www.bizjournals.com/houston/stories/2003/11/17/daily7.html
"Anadarko, Partners Report Discovery at Samurai Prospect in GOM," NGI, June 25, 2009, https://www.naturalgasintel.com/anadarko-partners-report-discovery-at-samurai-prospect-in-gom/
"Anadarko: 'Substantial' Deepwater Discovery in Green Canyon," NGI, February 3. 2009, https://www.naturalgasintel.com/anadarko-substantial-deepwater-discovery-in-green-canyon/
"Anadarko's Lucius Taps Pliocene, Miocene Oil," Oil & Gas Journal, December 10, 2009, https://www.ogj.com/general-interest/companies/article/17277071/anadarkos-lucius-taps-pliocene-miocene-oil.
"Beacon Offshore Advances Ultra-deepwater Shenandoah Project," Oil & Gas Journal, September 6, 2021, https://www.ogj.com/general-interest/article/14210157/beacon-offshore-advances-ultradeepwater-shenandoah-project.
"BSEE Issues Rule Extending Development Time for Offshore Oil and Gas Leaseholders," VanNess Feldman LLP, June 16, 2017, https://www.vnf.com/bsee-issues-rule-extending-development-time-for-offshore.
"Chevron Drilling At Coronado Prospect," Hart Energy, June 18, 2014, https://www.hartenergy.com/activity-highlights/chevron-drilling-coronado-prospect-140990.
"Chevron Sanctions Anchor Project in the Deepwater U.S. Gulf of Mexico," Chevron Announcement, December 12, 2019, https://www.chevron.com/newsroom/2019/q4/chevron-sanctions-anchor-project-in-the-deepwater-us-gulf-of-mexico.

"Chevron sets test records at Jack appraisal in Gulf of Mexico," September 5, 2006, https://www.hartenergy.com/exclusives/chevron-sets-test-records-jack-appraisal-gulf-mexico-25329
"Deepwater GoM Discoveries Thinning," Offshore, January 1, 2005, https://www.offshore-mag.com/regional-reports/article/16762950/deepwater-gom-discoveries-thinning
"Glossary of Terminology Related to Responsible Gas," Colorado School of Mines, Payne Institute of Energy Policy, January 31, 2022.
"Kerr-McGee Capitalizes on Deepwater Hub With Satellite Discovery," Rigzone, July 1, 2005, https://www.rigzone.com/news/oil_gas/a/23562/kerrmcgee_capitalizes_on_deepwater_hub_with_satellite_discovery/
"Preparing for a Successful 20kPSI BOP Campaign," Athens Group Maritime Energy, December 14, 2015, https://athensgroupservices.com/preparing-for-a-successful-20kpsi-bop-campaign/
"Project 20K Aims to Unlock HP/HT Deepwater Reserves," Offshore, November 12, 2013, https://www.offshore-mag.com/deepwater/article/16761226/project-20k-aims-to-unlock-hpht-deepwater-reserves.
Berman, Art, "McMoRan Davy Jones Gas Discovery," The Oil Drum, January 18, 2010, http://theoildrum.com/node/6135
Fitzgibbon, Tim, "API Gravity," Energy Insights by McKinsey, https://www.mckinseyenergyinsights.com/resources/refinery-reference-desk/api-gravity/.
Lavis, Jason, "Shallow, Mid to Ultra Deepwater Definitions," Drillers, April 6, 2018, https://drillers.com/shallow-mid-to-ultra-deepwater-definitions/.
Whiteside, Jessica "Lessons Learned from Qualification of 20,000-psi Subsea BOP Stack," IADC Drilling Contractor, May 12, 2020, https://drillingcontractor.org/lessons-learned-from-qualification-of-20000-psi-subsea-bop-stack-56234.
American Association of Petroleum Geologists Wiki – Capillary Pressure, https://wiki.aapg.org/Capillary_pressure.
American Association of Petroleum Geologists Wiki – Deep-Water Marine Reservoirs, https://wiki.aapg.org/Deep-water_marine_reservoirs.
American Association of Petroleum Geologists Wiki – Dry Hole, https://wiki.aapg.org/Dry_hole.
American Association of Petroleum Geologists Wiki – Fault Seal Analysis for Reservoir Development, https://wiki.aapg.org/Fault_seal_analysis_for_reservoir_development

CONFIDENTIAL

American Association of Petroleum Geologists Wiki – Free Water Level Determination Using Pressure, https://wiki.aapg.org/Free_water_level_determination_using_pressure.
American Association of Petroleum Geologists Wiki – Hydrocarbon Migration, https://wiki.aapg.org/Hydrocarbon_migration.
American Association of Petroleum Geologists Wiki – Migration Pathway, https://wiki.aapg.org/Migration_pathway.
American Association of Petroleum Geologists Wiki – Predicting Hydrocarbon Recovery, https://wiki.aapg.org/Predicting_hydrocarbon_recovery.
American Association of Petroleum Geologists Wiki – Province, Basin, System, Play, and Prospect, https://wiki.aapg.org/Province,_basin,_system,_play,_and_prospect.
American Association of Petroleum Geologists Wiki – Reservoir Quality, https://wiki.aapg.org/Reservoir_quality.
American Association of Petroleum Geologists Wiki – Sequence Stratigraphy, https://wiki.aapg.org/Sequence_stratigraphy.
Encyclopedia Britannica – Fault (Geology), https://www.britannica.com/science/fault-geology.
Geological Digressions – The Mineralogy of Evaporites – Salt Tectonics, https://www.geological-digressions.com/the-mineralogy-of-evaporites-salt-tectonics/.
NS Energy Newsletter – Shenandoah Field Development, https://www.nsenergybusiness.com/projects/shenandoah-field-development/.
Oil & Gas Portal Technologies – Upstream | Field Appraisal Phase, https://www.oil-gasportal.com/upstream/field-appraisal-phase/.
Oil and Gas Wiki – Understanding Exploration and Appraisal, http://oilandgaswiki.blogspot.com/2014/03/understanding-exploration-and-appraisal.html
Schlumberger Energy Glossary – Allochthonous, https://glossary.slb.com/en/terms/a/allochthonous
Schlumberger Energy Glossary – API Gravity, https://glossary.slb.com/en/terms/a/api_gravity.
Schlumberger Energy Glossary – Autochthonous, https://glossary.slb.com/en/terms/a/autochthonous.
Schlumberger Energy Glossary – Oil-Water Contact, https://glossary.slb.com/en/terms/o/oil-water_contact.
Sheriff, Robert, "Encyclopedic Dictionary of Applied Geophysics," Society of Exploration Geophysicists, Definition of "Fault Seal Analysis". https://wiki.seg.org/wiki/Dictionary:Fault_seal_analysis

Sheriff, Robert, "Encyclopedic Dictionary of Applied Geophysics," Society of Exploration Geophysicists, Definition of "Resource" https://wiki.seg.org/wiki/Dictionary:Resource.
Sheriff, Robert, "Encyclopedic Dictionary of Applied Geophysics," Society of Exploration Geophysicists, Definition of "Viscosity" https://wiki.seg.org/wiki/Dictionary:Viscosity/en.
Sheriff, Robert, "Encyclopedic Dictionary of Applied Geophysics," Society of Exploration Geophysicists, Definition of "Wildcat Well" https://wiki.seg.org/wiki/Dictionary:Wildcat_well.
Society of Exploration Geophysicists Wiki – Depositional System, https://wiki.seg.org/wiki/Depositional_system.
Society of Exploration Geophysicists Wiki – Homocline, https://wiki.seg.org/wiki/Dictionary:Homocline.
Society of Exploration Geophysicists Wiki – Wide Azimuth., https://wiki.seg.org/wiki/Wide_azimuth.
Society of Petroleum Engineers PetroWiki – Appraisal Well, https://petrowiki.spe.org/Glossary:Appraisal_well.

APPENDIX 2 - CURRICULUM VITAE OF DR. ROCCO DETOMO, JR.

OMOTED Geophysical Consulting & Training
Home : [redacted]

email: Rocco.Detomo@Gmail.com
cell: [redacted]

Dr. Rocco (Rocky) Detomo, Jr

Objective Deliver world class technical Exploration geophysical advice, assessment, products, and training to O&G Industry E&P teams to insure the safe and optimal execution of subsurface evaluation & exploitation projects, including the application of Petrophysics & Geosciences to the exploration and production of hydrocarbons. Use 33 years of experience at Shell Oil Company and 7 years Consulting to deliver this advice and training, specifically focusing on the risking and evaluation of opportunities.

Geophysical Consultant 2014-Present CEO of *OMOTED* Geophysical Consulting, LLC. (retired from Shell Oil), Trustee for Society of Exploration Geophysicists (SEG) Foundation, Committee Chair of SEG Professional Society, Active Consultant and Legal Expert Witness.

Provide Expert Assessments, Geophysical Consulting, and Educational Training to Industry with particular focus on:

- Global Expert on Exploration & Appraisal Evaluations and Risking
- Expert on 4D Time-lapse acquisition design, PSTM & PSDM processing, interpretation, and training with emphasis on Ocean Bottom Nodes and electrical & fiber-based seabed sensor systems for Reservoir Monitoring
- VSP/Borehole Geophysics & Borehole data acquisition, evaluation, interpretation & training
- Exploration Opportunity Evaluation and Risking
- Quantitative & Integrated Subsurface Interpretation, including Amplitude Analysis, AvO & Seismic Inversion, and borehole geophysics
- Fiber communications and sensor systems, including buried land systems, downhole/borehole systems, and seafloor systems.
- Exploration & Production Upstream Business Training

Research Experience

2012-2014 Shell Head of Reservoir Surveillance Areal Monitoring Research- Houston, Texas

Lead & Train 2 Teams (17 staff) of Subsurface Researchers, located in two cities (Houston, Texas & Rijswijk, The Netherlands), focused on Reservoir Surveillance & Monitoring via seabed nodal systems, Life-of-Field systems & fiber optics. Research was directed in 4 areas: 1) Marine Areal Seismic Monitoring using Ocean Bottom Node technology, including fiber-based permanent systems; 2) Land Areal Seismic Monitoring using buried permanent seismic acquisition systems; 3) Downhole Seismic Monitoring using DAS VSP fiber optic technology & a variety of downhole measurements, and 4) Marine Seafloor Geodesy. Responsible for ~$14MM/year budget and operated field trials in collaboration with Assets around the globe evaluating performance of: Deepwater Water Injection monitoring using emerging Nodal Systems; Onshore Steam Injection monitoring; Unconventional Hydro-Fracturing monitoring using borehole fiber optics; Depletion and seafloor Subsidence; and LoFS/PRM systems.

Serve on Society Exploration Geophysicists Board of Directors, SEAM Board of Directors, Integrated Earth and Distinguished Lectures Committees and as SEG Foundation Trustee. Serve as Geosciences Program Organizer & Panelist for Offshore Technology Conference and as Guest Editor for *Interpretation Journal*.

Overseas Experience

2008-2012 Shell Head of Reservoir Geophysics for Sub-Sahara Africa for Shell
Companies in Nigeria - Lagos, Nigeria

Lead & Train Teams of 15 Subsurface experts in 2 cities, (Lagos, Port Harcourt), responsible for all Offshore & Onshore Quantitative Interpretations, including the evaluation & risking of Exploration Prospects, support of Development and Appraisal Drilling & Borehole evaluations, and ongoing 4D Reservoir Surveillance and Reserves Bookings for Bonga & Erha Deepwater Fields. Pioneered Deepwater 4D PSTM & PSDM, Ocean Bottom Nodes in West Africa, Downhole Acoustic Systems and Experimental Seismic Processing Technologies.

Serve on Society Exploration Geophysicists Distinguished Lectures Panel and Foundation Scholarship Committees, 2012 SEG Regional Honorary Lecturer for Middle East & Africa on Ocean Bottom Nodes & Borehole Fiber for Reservoir Monitoring, Serve as Geosciences Program Organizer for Offshore Technology Conference Committee and Guest Editor for *The Leading Edge*.

Exploration Experience

2005-2008 Gulf of Mexico Exploration Seismic Manager – Houston, Texas

Manage $60MM/per year budget and helped direct 45 staff responsible for the purchase and seismic processing of all Shell Seismic Data and Seismic Services in the GoM. Deployed Beam, WEM and RTM imaging migration methods within Shell. Member of Shell's GoM Exploration Leadership Team responsible for Opportunity identification, rating & ranking for highly successful 2006 - 2008 U.S. Federal Offshore Lease Sales. Planned borehole evaluation projects for drilling and characterization of Exploration wells.

Technical Chairman for 2005 SEG Annual Meeting in New Orleans.

Technical reviewer for Professional Journals *Geophysics* and *Geophysical Prospecting*.

Global Deepwater Experience

2002-2005 Global Deepwater Technical Advisor, Shell E&P Solutions - New Orleans, Louisiana

Provided Deepwater Technical Subsurface Advisory for Brunei, Malaysia, North Atlantic, Egypt, Morocco, West Africa, Gulf of Mexico, and Brazil, including founder and Lead implementer for Shell's Global QIE, (Quantitative Integrated Evaluation), initiative, & Deepwater Risking Training.

Diverse, Middle Career Experience

1998–2002 GoM Geophysical Consultant, Reservoir Technologies - Shell Deepwater Services, New Orleans, Louisiana

Led multidisciplinary team in Exploration Prospect evaluation & risking, AvO & Amplitude Calibration, & served as Geophysical Discipline coordinator. Pioneered GoM Ocean Bottom Node Systems for Exploration Evaluation. President, Officer – Southeastern Geophysical Society. Shell Integrated Subsurface Conference Organizer & Univ-Lecturer at UNO.

1997-1998 "Cinnamon" Offshore Development Project Manager, Shell Offshore, Inc. - New Orleans, Louisiana

Supervised planning, construction and installation of technically innovative platform, deck and pipelines and development drilling in 700' water depth in Gulf of Mexico, ($120MM project is world's largest tripod. Led & Trained Sub-Salt Integrated Evaluation Team, including drilling and borehole evaluation.

Recipient of 1997 A.I. Levorsen Award for GCAGS Best Paper of 1997.

Treasurer – Southeastern Geophysical Society. Interpretation Technical Committee and Session

1995–1997 "Enchilada" Subsalt Development Interpreter, Shell Offshore, Inc. - New Orleans, Louisiana

Lead Staff Geophysical Interpreter for Subsalt Development, generating technically innovative detailed development plan for $300MM subsalt development project. Designed borehole

"Through salt" drilling and borehole evaluation projects.

Recipient of Houston Geologic Society 1997 Best Paper of the Year.

1992–1995 "South Pass 62" Redevelopment Interpreter, Shell Offshore, Inc. - New Orleans, Louisiana

Lead Geophysical Interpreter for Mature Field Redevelopment deploying first GoM horizontal wells. Trainer for "Redevelopment Best Practices" within Shell Gulf of Mexico

Broad, Early Career Experience

1989–1992 Senior Systems Analyst, Shell Information Technologies - Houston, Texas

Responsible for IT for E&P Americas, including moving to Cray Supercomputers.

Awarded Shell Oil Company's President's Award for Seismic Processing Turnaround Facility Technology planning and implementation.

1988–1989 Senior Geophysical Interpreter Coastal California, Shell Western E & P, Inc - Houston, TX

Identifying Monterey subthrust fault traps in onshore coastal California strike-slip system using innovative 2D seismic designs, swath and gravity interpretation.

1983–1988 Senior Geophysicist & Seismic Land Acquisition Crew Chief, Shell Western E & P, Inc - Houston, TX

Operated land vibroseis, heliportable, deep shot-hole, and shallow auger hole seismic acquisition operations crews in Michigan, Colorado, Montana, Oklahoma, Arkansas, Texas, Washington and California. Shell's Onshore Seismic Processing Instructor for Noise Elimination and Statics.

1981–1983 Seismic Processing Geophysicist, Shell Western E & P, Inc - Houston, TX Processed seismic in Michigan, Washington Columbia Basalt, Arkansas Ouachita Overthrust Belt, and West Texas. Introduced Vibroseis and Ground-Force Monitoring to Shell U.S.A.

Shell international training instructor for technical short courses.

Education

1970–1972 U. S. Air Force Academy Colorado Springs, CO

1972–1981 Ohio State University Columbus, OH

BS, Physics, Graduated Summa Cum Laude

MS, Physics, Graduated Summa Cum Laude

Ph.D., Nuclear Physics

External	Board of Directors SEG; Board of Directors SEG Foundation, Member EAGE, APS, Sigma Xi; President of SEG-SGS 2001. SEG Technical Chairman 2006, 2015. 2012 Regional Honorary Lecturer for Middle East & Africa, Member SEG Foundation Trustees & Scholarship & Distinguished Lectures Committees
Hobbies	Former USA Regional Player for USA Rugby, National "B" Licensed Soccer Coach, National "C" Licensed Soccer Referee, Licensed Bareboat Charter Sailing Captain, Worldwide Adventure Hiker, Bicycling Enthusiast

APPENDIX 3 – DR. ROCCO DETOMO JR'S LIST OF PUBLICATIONS

Oct 2018 Conference Paper: On the cusp of change for Learning in the Oil & Gas Industry. Rocco Detomo

Jun 2014 Conference Paper: Distributed Acoustic Sensing (DAS) for Reservoir Monitoring with VSP. Albena Mateeva · Jorge Lopez · Rocky Detomo · H. Potters · Wilfred Berlang · Samantha Grandi · Jeff Mestayer · Peter Wills · Barbara Cox · Denis Kiyashchenko

May 2014 Article: Distributed Acoustic Sensing for Reservoir Monitoring with Vertical Seismic Profiling. Albena Mateeva · Jorge Lopez · Hans Potters · Jeff Mestayer · Barbara Cox · Denis Kiyashchenko · Peter Wills · Samantha Grandi · Kees Hornman · Boris Kuvshinov · Wilfred Berlang · Zhaohui Yang · Rocco Detomo

Jan 2014 Conference Paper: Recent Advances in Seismic Monitoring of Thermal EOR. Albena Mateeva · Jorge Lopez · Kees Hornman · Peter Wills · Barbara Cox · Denis Alexandrovich Kiyashchenko · Wilfred Berlang · Hans Potters · Rocco Detomo

Jan 2014 Article: Recent Advances in Seismic Monitoring of Thermal EOR. Albena Mateeva · Jorge Lopez · Kees Hornman · Peter Wills · Barbara Cox · Denis Alexandrovich Kiyashchenko · Wilfred Berlang · Hans Potters · Rocco Detomo

Sep 2013 Article: Ocean Bottom Node Seismic: Learnings from Bonga, Deepwater Offshore Nigeria. Rocco Detomo, Jr. · Edwin Quadt · Carlos Pirmez · Reginald Mbah · Samuel Olotu

July 2013 Conference Paper: Recent Advances in Seismic Monitoring of Thermal EOR. Albena Mateeva · Jorge Lopez · Kees Hornman · Peter Wills · Barbara Cox · Denis Kiyashchenko · Wilfred Berlang · Hans Potters · Rocco Detomo

Jun 2013 Conference Paper: Ocean Bottom Node Seismic at the Deepwater Bonga Field, Nigeria. Edwin Quadt · Rocco Detomo · Carlos Pirmez · Reginal Mbah · Paul Milcik · Samuel Olotu · Jake Emakpor

Mar 2013 Article: Ocean Bottom Node Seismic at the Deepwater Bonga Field Nigeria. Edwin Quadt · Rocco Detomo · Carlos Pirmez · Reginald Mbah · Paul Milcik · Samuel Olotu · Jake Emakpor

Jan 2013 Conference Paper: Ocean Bottom Node Seismic at the Deepwater Bonga Field, Nigeria. Edwin Quadt · Rocco Detomo · Carlos Pirmez · Reginald Mbah · Paul Milcik · Samuel Olotu · Jake Emakpor

Lecture Series 2012 SEG Honorary Lecturer: 4D Time-Lapse Seismic Reservoir Monitoring of African Reservoirs. Rocco Detomo, Jr.

Jun 2011 Article: Introduction to this special section: Africa. Samuel Olotu · Rocco Detomo · Alan Jackson

Jan 2011 Conference Paper: Life-cycle seismic for turbidite fields in Deepwater Nigeria. Rocco Detomo · Edwin Quadt

Jun 2009 Conference Paper: The Bonga 4D: Shell Nigeria's First Deepwater Time Lapse Monitor. A. Adejonw · I. Al-Mandhary · R. Detomo Jr · O. Effiom · W. Gouveia · N. Kremers · E. Legius · A. Maclellan · R. Mcclenaghan · A. Onuwaje · E. Quadt · S. Weaver

Jan 2006 Chapter: Analyzing power measurements for the 4-nucleon system below 6 MeV. T. R. Donoghue · R. Detomo · L. J. Dries · H. W. Clark

May 2005 Article: Quantitative Integrated Evaluation in the Mars Basin, Gulf of Mexico. B. W. Tichelaar · R. Detomo

Jan 2005 Article: Quantitative Integrated Evaluation with Explicit Large-Scale Shared Earth Models for Ursa Field. R. Detomo · B. Tichelaar

Jun 1993 Article: 4 Results and Conclusions of a Horizontal-drilling. E. P. Mason · M. J. Bastian · R. Detomo · M. N. Hashem · A. J. Hildebrandt

May 1981 Thesis: Polarization transfer coefficients at Ed = 6 MeV for the charge symmetric $^3H(d, n)^4He$ and $^3He(d, p)^4He$ reactions. Rocco. Detomo

Mar 1981 Article: Charge symmetric reactions T(d,n)4He and 3He(d,p)4He below 6 MeV. H. W. Clark · R. Detomo · L. J. Dries · T. C. Rinckel · J. C. Brown · T. R. Donoghue

Mar 1981 Article: Polarization transfer coefficient measurements for the 3He(d,p)4He reaction. R. Detomo · H. W. Clark · T. C. Rinckel · J. C. Brown · T. R. Donoghue

Feb 1980 Article: Az(0) for the charge-symmetric 3He(d,p)4He and 3H(d,n)4He reactions below 6. 75 MeV. L.J. Dries · H.W. Clark · R. Jr. Detomo · J.L. Regner · T.R. Donoghue

May 1979 Article: Az(0) for the charge-symmetric $^3He(d,p)4He$ and $^3H(d,n)4He$ reactions below 6. 75 MeV. L. J. Dries · H. W. Clark · R. Jr. Detomo · J. L. Regner · T. R. Donoghue

Jan 1979 Article: Comparison of analyzing powers for the charge symmetric reactions 2H(d,n)3He and 2H(d,p)3H below 5.5 MeV. L. J. Dries · H.W. Clark · R. Detomo · T.R. Donoghue, Physics Letters B

Jan 1979 Article: Analyzing power measurements for p-3He elastic scattering from 1.75 to 4.50 MeV. R. Detomo Jr · H.W. Clark · L.J. Dries · J.L. Regner · T.R. Donoghue, Nuclear Physics A

APPENDIX 4 – DR. ROCCO DETOMO JR'S TESTIMONY IN THE LAST FOUR YEARS

Magseis FF LLC, et al. v. Seabed Geosolutions (US) Inc., et al., No. 4:17-cv-01458 (S.D. Tex.), Expert deposition testimony

Exhibit 26

UNITED STATES DISTRICT COURT

SOUTHERN DISTRICT OF TEXAS

HOUSTON DIVISION

In re ANADARKO PETROLEUM CORPORATE SECURITIES LITIGATION	)	Civil Action No. 4:20-cv-00576
	)	REBUTTAL REPORT OF KEVIN J. MURPHY

Rebuttal Report of Kevin J. Murphy

1. Introduction 1

2. Summary of Opinions 4

3. Executive Compensation at Anadarko Petroleum 5

3.1. Overview 5
3.2. Annual Bonuses (AIP) 6
3.3. Restricted Stock Units (RSUs)... 8
3.4. Non-Qualified Stock Options (NQSOs) 9
3.5. Performance Units (PUs) 9

4. Stock Ownership and Trading Patterns for Named Defendants, 2014-2018 11

4.1. Mr. Walker 11
4.2. Mr. Gwin 12
4.3. Mr. Daniels 13
4.4. Mr. Leyendecker 14

5. Did Named Defendants benefit financially from the alleged stock-price inflation through increased compensation? 15

5.1. Annual Bonuses (AIP) 16
5.2. Restricted Stock Units (RSUs)... 17
5.3. Non-Qualified Stock Options (NQSOs) 19
5.4. Performance Units (PUs) 21
5.5. Summary 25

6. Did Named Defendants benefit financially from the alleged stock-price inflation through their trading activities? 25

6.1. Mr. Walker 26
6.2. Mr. Gwin 27
6.3. Mr. Daniels 28
6.4. Mr. Leyendecker 29
6.5. Summary 30

7. Did the alleged misstatement with respect to Shen-3 impact bonus awards to Anadarko management? 31

8. Did the alleged inflation increase the payments to the Named Defendants in connection with the August 2019 acquisition by Occidental? 35

9. Author's Statement and Qualifications 37

Exhibit A: Curriculum Vitae 62

Exhibit B: Testifying Experience in the Last Five Years 76

Exhibit C: Materials Considered in Producing this Report 77

Rebuttal Report of Kevin J. Murphy

1. Introduction

In its Form 10-Q filed after market close on May 2, 2017, Anadarko Petroleum Corporation ("Anadarko") reported its first-quarter financials for 2017. In that filing, Anadarko disclosed that it had suspended further appraisal activities of the Shenandoah oil prospect.[1] In their Amended Complaint (the "Complaint"), Plaintiffs allege that Anadarko executives Robert "Al" Walker ("Mr. Walker"), Robert G. Gwin ("Mr. Gwin"), Robert P. Daniels ("Mr. Daniels") and Ernest A. Leyendecker, III ("Mr. Leyendecker") (collectively, the "Named Defendants") made false and misleading statements to conceal that Shenandoah was not commercially viable from February 20, 2015 to May 2, 2017 (the "Class Period"). Among approximately 20 other allegedly false and misleading statements, Plaintiffs allege that Anadarko knew but failed to disclose that the "Shen-3" appraisal well was a "dry hole" since at least February 20, 2015 (the start of the "Class Period"), and as a consequence failed to expense the exploratory well costs until the third quarter of 2016.[2]

As a result of the alleged misstatements (the "alleged fraud"), Plaintiffs' expert Bjorn I. Steinholt ("Mr. Steinholt") contends that the price of Anadarko's common shares was artificially inflated by $1.75 per share from February 23, 2015 through July 26, 2016, and by $1.92 per share from July 27, 2016 through May 2, 2017.[3] In addition, Plaintiffs' expert

[1] Anadarko Petroleum Corporation Form 10-Q filed May 2, 2017, Note 5 (p. 13).

[2] Amended Complaint, August 17, 2020, ¶¶ 4, 97-139; Anadarko Petroleum Corporation Form 10-Q filed October 31, 2016, p. 11.

[3] Expert Report of Bjorn I. Steinholt, CFA dated November 9, 2022 (the "Steinholt Report"), ¶¶ 105-106 and Exhibit D. Mr. Steinholt contends that the price of Anadarko shares was correct on February 20, 2015, and May 3, 2017 (the beginning and ending of the Class Period, respectively).

D. Paul Regan ("Mr. Regan") drew a connection between executive bonuses and the alleged delay in expensing suspended exploratory well costs.[4] Plaintiffs also contend that the Named Defendants benefited from the alleged fraud through golden parachute payments received in connection with the August 2019 acquisition of Anadarko by Occidental Petroleum Corporation ("Occidental").[5]

I, Kevin J. Murphy, have been retained by Cravath, Swaine & Moore LLP, counsel for Anadarko and the Named Defendants, to assess Plaintiffs' assertions that the Named Defendants stood to benefit financially from the alleged fraud. In particular, I have been asked to analyze and assess:

- whether the Named Defendants benefited financially from the alleged stock-price inflation through increased compensation;
- whether the Named Defendants benefited financially from the alleged stock-price inflation through their trading activity;
- whether the alleged misstatements with respect to Shen-3 increased the bonus awards to Named Defendants; and
- whether the alleged inflation in Anadarko's stock prices during the Class Period increased the amounts received by the Named Defendants in connection with the acquisition by Occidental.

As described in detail in Section 9 below, I hold the Kenneth L. Trefftzs Chair in Finance at the University of Southern California Marshall School of Business. I am a recognized expert on executive compensation, and have written more than fifty articles, case studies, books, and book chapters relating to compensation and incentives in organizations. I have served as a compensation consultant on issues related to CEO pay for many public and private companies,

[4] Expert Report of D. Paul Regan, CPA/CFF dated November 9, 2022 (the "Regan Report") ¶¶ 77(c), 86.

[5] Complaint, ¶¶ 5(s), 9, 150.

and I have provided expert testimony related to executive compensation to Congress, the Court of Chancery of the State of Delaware, and in other federal and state Courts.

I am being compensated for my work on this matter at my customary billing rate of $1,200 per hour. While the opinions expressed herein are entirely my own, I have been assisted in this matter by staff of a research firm, Compass Lexecon, who worked under my direction and supervision. My compensation, and that of Compass Lexecon, is neither contingent nor dependent on the outcome of this matter. The conclusions in this report are my own.

My report proceeds as follows. My opinions are briefly summarized in Section 2. In Section 3, I describe Anadarko's executive compensation practices and policies, focusing on components potentially impacted by the alleged fraud. Section 4 describes the stock ownership and trading activities for the Named Defendants from 2014–2018 (*i.e.*, from the calendar-year before the Class Period to the calendar-year after the Class Period). Sections 5–8 provide my opinions related to the four bullet points above, respectively. My qualifications are described in Section 9, "Author's Statement and Qualifications," and I have attached my curriculum vitae at the end of this report as Exhibit A. A list of cases in which I have testified or given depositions within the last five years is attached as Exhibit B. In performing my analysis, I have relied upon materials produced in this case and other publicly available information. A list of the materials upon which I have relied in forming my opinions in this report is attached as Exhibit C.

I reserve the right to amend this report to reflect any additional information obtained after the submission of this report. I also reserve the right to supplement this report to address additional issues raised by Plaintiffs' experts in the pending litigation.

2. Summary of Opinions

2.1. Did Named Defendants benefit financially from the alleged stock-price inflation through increased compensation?

- No. The Named Defendants did not benefit financially from the alleged inflation through increased compensation. In fact, I find that each Named Defendant would have been better off financially if Anadarko's stock price had been \$1.75 or \$1.92 per share lower during the Class Period.

2.2. Did Named Defendants benefit financially from the alleged stock-price inflation through their trading activity?

- No. I find no evidence that trades by Named Defendants were "in suspicious amounts or at suspicious times" during the Class Period.[6] In fact, I find no evidence that the Named Defendants sold shares during the Class Period when prices were allegedly inflated, but instead kept reinvesting vested Restricted Stock Units ("RSUs") and exercised options into Anadarko, and (in the case of Mr. Walker) made large open-market purchases of Anadarko shares just after the Class Period.
- In addition, I find relevant the fact that Anadarko increased its working interest in the Shenandoah project from 30% to 33% at a time when Named Defendants allegedly had inside information that the project was a failure. This increased working interest would negatively impact the post-Class Period value of the Named Defendants' stock holdings and the vesting value of their equity-based compensation.

2.3. Did the alleged misstatements with respect to Shen-3 increase bonus awards to Anadarko top executives?

- No. In fact, I find that expensing the Shen-3 cost in 2014 rather than in 2016 would have had no effect on 2014 executive bonuses but would have increased 2016 executive bonuses.

[6] I understand that the Fifth Circuit has found that trading "in suspicious amounts or at suspicious times" may be suggestive of scienter. *See Southland Sec. Corp. v. INSpire Ins. Sols., Inc.*, 365 F.3d 353, 368 (5th Cir. 2004). Such suspicious trades include trades that are "dramatically out of line with prior trading practices at times calculated to maximize the personal benefit from undisclosed inside information." *Id.* (citing *In Re Silicon Graphics Inc. Securities Litigation*, 183 F.3d 970, 987 (9th Cir. 1999)). My assessments with respect to suspicious timing or amount of trading are from the perspective of my expertise in economics and are not legal opinions.

- In addition, I note that Anadarko's bonus structure for top executives does not include anything related to unproved reserves.

2.4. Did the alleged stock-price inflation increase the golden parachute payments to the Named Defendants in connection with the August 2019 acquisition by Occidental?

- No. I estimate that the Named Defendants would have realized approximately $1.3 million in additional payouts in connection with the Occidental acquisition *absent* the alleged inflation, across all pay components.

3. Executive Compensation at Anadarko Petroleum

3.1. Overview

Anadarko's executive compensation plans and policies are described in detail in Anadarko's DEF 14A or "Proxy Statements" issued each March in advance of the annual meeting of shareholders. As emphasized in every Proxy Statement from 2010 through 2019, executive compensation at Anadarko is established and administered by the Compensation and Benefits Committee (the "Committee") consisting solely of independent outside directors. The Committee has overall responsibility for approving and evaluating Anadarko's director and officer compensation plans, policies, and programs. Since 2011, the Committee has been assisted by its independent executive compensation consultant, Frederick W. Cook & Company, Inc.[7]

As described in the Compensation Discussion and Analysis section of each Proxy Statement, executive compensation at Anadarko consists of three primary components: base salary, annual bonus, and long-term incentives in the form of Restricted Stock Units ("RSUs"),

[7] Prior to 2011, the Committee's outside consultant was Hewitt Associates LLC; it briefly retained Meridian Compensation Partners, LLC in late 2010 after its separation from Hewitt. *See* Anadarko Petroleum Corporation DEF 14A (Proxy) Statement filed March 25, 2011, p. 34.

Non-Qualified Stock Options ("NQSOs"), and Performance Units ("PUs"), as described in detail below.[8] Table 1 summarizes the 2014–2018 target compensation for the Named Defendants. As shown in the table, target compensation for Mr. Walker, Mr. Gwin, and Mr. Daniels did not change from the calendar-year before the Class Period to the calendar-year after the Class Period, and Mr. Leyendecker's target compensation changed only upon his promotion to Executive Vice President ("EVP") in August 2016. Target Bonuses are defined as a percentage of Base Salary (130% for Mr. Walker and 95% for EVPs). Target Equity awards are expressed in dollars and are allocated across PUs, RSUs, and NQSOs based on predetermined percentages.[9] Since 2015, EVPs and above have received 50% of their equity compensation in PUs, and 25% each in RSUs and NQSOs.

3.2. Annual Bonuses (AIP)

Bonuses under Anadarko's Annual Incentive Plan ("AIP") are determined by the following formula:[10]

$$\boxed{\begin{array}{c}\text{Target Bonus}\\ \text{(Base Salary × Target Bonus \%)}\end{array}} \times \boxed{\begin{array}{c}\text{AIP}\\ \text{Performance}\\ \text{Score}\end{array}} \pm \boxed{\begin{array}{c}\text{Individual}\\ \text{Performance}\\ \text{Adjustment}\end{array}} = \boxed{\begin{array}{c}\text{Actual}\\ \text{Bonus}\\ \text{Earned}\end{array}}$$

Each February, Anadarko's Compensation Committee (the "Committee") meets to approve the specific performance measures that determine the AIP Performance Score for the current

8 While not relevant to my opinions and analyses, Anadarko executives also participated in qualified and non-qualified pension and deferred-compensation programs.

9 The target equity percentages are reported in the Proxy Statements. The Total Target Equity amounts in Table 1 differ slightly from the amounts reported in Anadarko's proxy statements because the latter is based on finalized accounting values under ASC Topic 718. The targets in Table 1 are derived from various sources, including APC-00779479 at 527; APC-00786269 at 275; APC-00771156 at 156; APC-00790771 at 777, 788; APC-00790250 at 256, 267.

10 *See*, *e.g.*, Anadarko Petroleum Corporation DEF14A Proxy Statement filed March 17, 2017, p. 43.

year and to certify performance results for the prior year.[11] Table 2 summarizes the performance measures and weights used for the AIP Performance Score from 2014–2018, generally consisting of the following: *operational measures* tied to proved reserves and sales volumes (in million barrels of oil equivalents, or "MMBOE"),[12] *financial measures* (*e.g.*, capital expenditures, controllable cash costs), and *safety measures* (*e.g.*, Total Recordable Incident Rate).

Each performance measure in Table 2 is measured against a target performance goal also approved by the Committee at its February meeting. The performance goals are based on Anadarko's annual capital budget, which in turn is based on a company-wide portfolio evaluation effort led by the company's Corporate Planning team with multiple reviews by both executive management and the Board of Directors.[13] The Committee approves the associated AIP performance goals to align with the short- and long-term strategic objectives of the budget. The Committee then monitors progress during the year, reserving the right to adjust the goals based on various internal and external factors that might arise during the year. In addition, the Committee can use its discretion to *reduce* (but not increase) the year-end AIP Performance Score. Payouts under the AIP are capped at 200% of each executive's Target Bonus.

---

[11] *See*, *e.g.,* Minutes from the Anadarko Petroleum Corporation Scheduled Meeting of the Compensation and Benefits Committee of the Board of Directors, February 10, 2014 (APC-00775465-471); February 8, 2016 (APC-00783560-573); February 8, 2017 (APC-00787943 at 944-952); February 12, 2019 (APC-00790975 at 976-984).

[12] As defined by the Financial Accounting Foundation, proved oil and gas reserves include only quantities of oil and gas which, by analysis of geoscience and engineering data, can be estimated with reasonable certainty to be economically producible (*see* Master Glossary – Proved Oil and Gas Reserves, Financial Accounting Foundation, 2022). Notably, Anadarko did not book any reserves in connection with the Shenandoah prospect during the Class Period (*see* Deposition of Charles F. Oudin, III dated June 30, 2022, 243:7-11).

[13] The budget process and the determination of the AIP performance measures and goals is described in the Compensation Discussion and Analysis of each DEF 14A (Proxy) Statement.

Table 3 shows the actual payouts under the AIP for Anadarko's Named Executive Officers (or "NEOs," defined as the executive officers named in proxy statements) from 2014–2018. The actual bonus received by any NEO is determined by multiplying the NEO's Target Bonus by the Final AIP Bonus percentage. For example, Mr. Walker's 2014 bonus was $2,551,900, which is 151% of his Target Bonus (which in turn is 130% of his $1.3 million base salary). As shown in the table, the Committee used its discretion to reduce bonuses by 86.5% in 2015, and by 7.6% in 2017. No NEO received an individual performance adjustment from 2014 to 2018.

3.3. Restricted Stock Units (RSUs)

As shown in Table 1, 25% of the equity pay for Anadarko EVPs or higher is conveyed in the form of RSUs, which vest equally over three years beginning one year from the grant date. The number of RSUs granted to each executive in each year is determined by dividing 25% of that executive's Target Equity Award by the closing price of Anadarko common stock on the grant date.

Upon vesting, the market value of the Anadarko shares associated with the RSUs is considered ordinary taxable income to the recipient. To satisfy the tax obligations, Anadarko reduces the number of RSUs subject to the applicable vesting period by the number of RSUs equal to the applicable withholding taxes, resulting in the distribution of net shares to the participant.[14] Dividends on RSUs are accrued and reinvested quarterly in additional shares of Anadarko common stock and paid, less applicable withholding taxes, upon vesting.

---

14 *See* APC-00776406 at 419 (2014); APC-00780428 at 444 (2015); APC-00786209 at 217 (2016); APC-00790250 at 259 (2017); APC-00790771 at 780 (2018). The shares withheld by Anadarko are noted by the Transaction Code "F" in the Form 4s of the Named Defendants.

3.4. Non-Qualified Stock Options (NQSOs)

Stock options give the recipient the right, but not the obligation, to purchase shares at a predetermined "exercise price" over a predetermined period. Stock options for Anadarko executives—comprising 25% of the equity pay for Anadarko CEO and EVPs from 2014 through 2018—have a term of seven years and are granted with an exercise price equal to the closing stock price on the grant date.[15] The number of NQSOs granted to each executive in each year is determined by dividing 25% of that executive's Target Equity Award by the calculated value per option as of the grant date.[16]

Anadarko stock options become exercisable over three years, beginning one year from the grant date. When options are exercised, the difference between the stock price on the exercise date and the exercise price is considered taxable ordinary income to the recipient. Under Anadarko's Stock Option plans, employees exercising options can deliver cash or use shares of Company stock for full or partial payment of the exercise price and the minimum tax withholding due upon exercise.[17]

3.5. Performance Units (PUs)

Anadarko's Performance Unit plan is a cash plan where the payoffs are based on both Anadarko's stock price and its Total Shareholder Return ("TSR").[18] In particular, in each year

15 Senior Vice Presidents ("SVPs"), including Mr. Leyendecker prior to his August 2016 promotion to EVP, had a Target NQSO Percentage of 35% in 2014 and 2015. *See* APC-00789245 at 286.

16 These values differ slightly from the ASC 718 values reported in the proxy statements.

17 *See* APC-00776406 at 418 (2014); APC-00780428 at 443 (2015); APC-00786209 at 215 (2016); APC-00790250 at 257 (2017); APC-00790771 at 778 (2018).

18 For purposes of PU vesting, TSR for Anadarko and its 11 peers is defined as the average closing stock price for the last 30 trading days of the performance period *minus* the average closing stock price for the 30 trading days preceding the beginning of the performance period *plus* dividends per share over the performance period, all divided by the average closing stock price for the 30 trading days preceding the beginning of the performance period *See* APC-00776406 at 420 (2014); APC-00780428 at 445 (2015); APC-00786209 at 219 (2016); APC-00790250 at 261 (2017); APC-00790771 at 782 (2018).

each executive is granted a "target number" of PUs. Each PU conveys the right for the participant to receive the cash value of one share of Anadarko stock, but the number of PUs conveyed depends on Anadarko's TSR rank relative to the TSR realized by eleven peer companies. Table 4 shows the payoff levels under Anadarko's PU plan, reflecting differences for grants made before November 2014 and in or after November 2014. In both time periods, executives will receive the cash value of 200% of target PUs if Anadarko is at the top of the 12-firm cohort (*i.e.*, Anadarko plus 11 peers), and will receive nothing if Anadarko is ranked among the bottom three of the cohort.

Half (50%) of the grants before November 2014 were based on two-year TSR performance, and the remaining 50% were based on three-year TSR performance; grants made in November 2014 or after are based only on three-year TSR performance. Grants are typically made in late October or early November, with the performance period commencing on the following January 1st.[19] For example, the three-year performance period for the grant made on November 6, 2014 is January 1, 2015 through December 31, 2017.[20]

The target number of PUs granted to each executive (EVP and above) is determined by dividing 50% of the Target Equity Award by the value of each PU, which in turn is calculated using a Monte Carlo estimation that takes into account the payoff structure in Table 4 and the relative probabilities (and associated stock prices) of ending up at each performance rank.[21] Given the convexity inherent in Table 4 (*e.g.*, more PUs are granted when stock prices are

---

[19] The only exception for the Named Defendants with unvested PUs from 2014–2018 was a special grant to Mr. Walker made on May 15, 2012 in connection with his appointment as Anadarko's President and CEO. Half of this grant vested based on Anadarko's relative TSR ranking from May 15, 2012 to May 14, 2014, while the other half vested based on Anadarko's relative TSR ranking from May 15, 2012 to May 14, 2015. *See* Anadarko Petroleum Corporation DEF14A Proxy Statement, filed March 23, 2015, p. 50 and Anadarko Petroleum Corporation DEF14A Proxy Statement, filed March 18, 2016, p. 51.

[20] *See* Anadarko Petroleum Corporation DEF 14A (Proxy) Statement filed March 23, 2015, p. 62.

[21] *See* APC-00789245 at 253.

higher), the per-unit value of each PU granted from 2014 to 2018 averages about 10% higher than the grant-date stock price.[22] Accordingly, the target number of PUs granted each year (representing 50% of the Target Equity Award) will be somewhat less than twice the target number of RSUs granted each year (representing 25% of the Target Equity Award).

4. Stock Ownership and Trading Patterns for Named Defendants, 2014-2018

4.1. Mr. Walker

Figure 1 depicts Mr. Walker's holdings of Anadarko shares, unvested RSUs, and stock options from January 2014 through December 2018, including shares held indirectly in an LLC. In August 2014, six months prior to the Class Period, Mr. Walker exercised 62,200 options from his November 2007 grant due to expire in November 2014, selling all the shares acquired (including shares sold to pay the exercise price and taxes).[23] The same month, he also exercised 182,900 options from his November 2008 grant due to expire in November 2015, again selling all shares acquired.[24] Mr. Walker did not exercise any other options from 2014–2018, and also retained all vesting RSUs beyond those that Anadarko withheld for tax purposes.[25] Mr. Walker sold no Anadarko shares during the Class Period, and his only other transaction between 2014 and 2018 was an open market purchase of 19,300 Anadarko shares on May 17, 2017, two weeks after the end of the Class Period.[26]

---

[22] As with stock options, the PU values used by the Committee in finalizing grants differ slightly from the ASC 718 values reported in the proxy statements.

[23] R. A. Walker Form 4 filed August 8, 2014.

[24] R. A. Walker Form 4 filed August 8, 2014.

[25] Options granted to Mr. Walker in November 2009, November 2010, and November 2011 expired out-of-the-money (*i.e.*, the exercise price exceeded Anadarko's stock price on the expiration date, and therefore expired unexercised).

[26] R. A. Walker Form 4 filed May 17, 2017.

Under Anadarko's Stock Ownership Guidelines for Non-Management Directors and Executive Officers ("Stock Ownership Guidelines"), Mr. Walker (as Anadarko's CEO) is required to hold six times his base salary in Anadarko shares or RSUs.[27] Based on his $1.3 million base salary from 2014–2018, Mr. Walker was therefore required to hold $7.8 million in shares or RSUs.[28] Figure 2 shows the value of Mr. Walker's shares and RSUs, where (consistent with the Stock Ownership Guidelines) the value is defined as Mr. Walker's shares (or RSUs) multiplied by the average daily stock price over the preceding year. As evident from the figure, Mr. Walker's ownership significantly exceeded his ownership requirements throughout the depicted time period.

4.2. Mr. Gwin

Figure 3 depicts Mr. Gwin's holdings of Anadarko shares, unvested RSUs, and stock options from January 2014 through December 2018, including Anadarko shares held in his 401(k) Plan. In August 2014, Mr. Gwin exercised all remaining options from his soon-to-expire November 2007 and March 2008 grants, selling all the shares acquired (including those used to pay the exercise price and taxes).[29] Mr. Gwin also exercised remaining options from his November 2008 grant in October 2015 (a month before expiration), and the remaining options from his March 2009 grant in February 2016 (a day before expiration), *retaining* all the net shares acquired (after Anadarko withheld enough shares to pay the exercise price and taxes).[30] He also retained all net shares acquired when RSUs vested. Beyond these transactions,

---

27 *See*, *e.g.,* Anadarko Petroleum Corporation DEF 14A (Proxy) Statement filed March 23, 2015, p. 57.

28 To mitigate short-term fluctuations in Anadarko stock prices, compliance under the Stock Ownership Guidelines is based on the trailing 52-week daily average stock price.

29 Robert G. Gwin Form 4 filed August 8, 2014.

30 Robert G. Gwin Form 4s filed October 9, 2015 and March 2, 2016, indicating shares withheld by Anadarko by Transaction Code "F".

Mr. Gwin's only other transactions from 2014 to 2018 were November 2017 transfers of 57,064 Anadarko shares and 2018 RSUs (upon vesting) to his ex-wife pursuant to a domestic relations order; these transfers occurred after the Class Period.[31] Mr. Gwin did not sell or transfer any Anadarko shares during the Class Period.

Under Anadarko's Stock Ownership Guidelines, Mr. Gwin (like other EVPs) was required to hold three times his base salary in Anadarko shares or RSUs. Based on his $750,000 base salary from 2014–2018, Mr. Gwin was therefore required to hold $2,250,000 in shares or RSUs.[32] Figure 4 shows the value of Mr. Gwin's shares and RSUs, where value is again defined based on the average daily stock price over the preceding year. As evident from the figure, Mr. Gwin's ownership significantly exceeded his required ownership throughout the depicted time period, even after the sizable November 2017 transfers to his ex-wife.

4.3. Mr. Daniels

Figure 5 depicts Mr. Daniels' holdings of Anadarko shares, unvested RSUs, and stock options from January 2014 through his retirement in December 2016, including Anadarko shares held in his family's Limited Partnership and his 401(k) Plan. Pursuant to a divorce decree, Mr. Daniels exercised and sold soon-to-expire options in both April 2014 and March 2015 at his ex-wife's request.[33] In May 2014 (prior to the Class Period), he exercised and sold options, and additionally sold 10,000 Anadarko shares he held directly.[34] In October 2015, Mr. Daniels exercised soon-to-expire options, retaining all net shares acquired (after Anadarko

[31] Robert G. Gwin Form 4 filed November 8, 2017.

[32] To mitigate short-term fluctuations in Anadarko stock prices, compliance under the Stock Ownership Guidelines is based on the trailing 52-week daily average stock price.

[33] Robert P. Daniels Form 4s filed April 11, 2014 and March 24, 2015. Both Form 4s note that Mr. Daniels "had previously transferred the economic interest in these stock options to his ex-wife pursuant to a divorce decree and has exercised/sold these options/shares at her request."

[34] Robert P. Daniels Form 4 filed May 22, 2014.

withheld enough shares to pay the exercise price and taxes).[35] He retained all net shares acquired upon vesting of RSUs, and had no other transactions prior to his retirement effective December 30, 2016. Excluding the transaction connected to his divorce decree, he did not sell any Anadarko shares from the beginning of the Class Period through his retirement.

As an EVP, Mr. Daniels was required to hold three times his $700,000 base salary in Anadarko shares or RSUs. As shown in Figure 6, Mr. Daniels' ownership significantly exceeded his required ownership from 2014 through his retirement in December 2016.

4.4. Mr. Leyendecker

Figure 7 depicts Mr. Leyendecker's holdings of Anadarko shares, unvested RSUs, and stock options from January 2014 through his retirement on June 1, 2018. Data from August 2016 onward (when Mr. Leyendecker was appointed as EVP) are based on required public disclosures of ownership and changes in ownership.[36] Between January 2014 and his retirement in June 2018, Mr. Leyendecker never sold shares or exercised options, and retained all shares acquired upon RSU vesting net of shares withheld by Anadarko to satisfy tax obligations.[37] Upon his retirement in June 2018, Mr. Leyendecker's outstanding RSUs became fully vested and converted into Anadarko shares.[38]

While a Senior Vice President ("SVP"), Mr. Leyendecker was required (under the Stock Ownership Guidelines) to hold shares and RSUs worth 2.5 times his Base Salary (which

---

35 Robert P. Daniels Form 4s filed October 16, 2015, indicating shares withheld by Anadarko by Transaction Code F.

36 Data for common stock holdings prior to August 2016 are less reliable. *See* footnote to Figure 7.

37 The depicted declines in outstanding options in March and May 2017 are due to options granted in March and May 2010 that expired out-of-the-money and were canceled.

38 *See* Ernest A. Leyendecker, III Form 4 filed June 5, 2018.

increased from $400,000 to $420,000 in January 2015).[39] Upon his promotion to EVP in August 2016, Mr. Leyendecker had three years to increase his holdings to $1,725,000 (*i.e.*, three times his new $575,000 Base Salary). As shown in Figure 8, Mr. Leyendecker was in compliance with Anadarko's Stock Ownership Guidelines at all times, and in fact reached $1,725,000 in holdings more than two-and-a-half years before required under the Guidelines.

5. Did Named Defendants benefit financially from the alleged stock-price inflation through increased compensation?

Shares of Anadarko common stock closed at $51.95 on May 3, 2017, down 7.69% from the closing price of $56.28 on the previous day. In his report, Mr. Steinholt contends that $1.92 of Anadarko's $4.33 share-price decline on that day was based on its disclosure that it was expensing suspended exploratory well costs in connection with the Shenandoah project.[40] Mr. Steinholt opines that Anadarko's share price was artificially inflated by $1.92 per share from July 27, 2016 through May 2, 2017, and by $1.75 per share from February 23, 2015 (the first trading day following the first alleged misleading statement) through July 26, 2016.[41] Mr. Steinholt's change in the alleged inflation on July 27, 2016 was based on Anadarko's

[39] *See* APC-00775517 at 520 showing salary $400,000 as of June 30, 2014, and APC-00784847 showing salary of $420,000 by year-end 2014 and again in 2015, and APC-00783757 at 784 showing 2016 salary (as SVP) of $420,000 prior to promotion.

[40] Steinholt Report, ¶ 99. To be clear, it is *not* my opinion that $1.92 of the May 3, 2017 price drop is attributable to the Shenandoah disclosure.

[41] Steinholt Report, ¶ 14(d) and footnote 5: "Because the Class Period began with an alleged misleading statement made after the market closed on [Friday] February 20, 2015, the first day with inflation as a result of that misleading statement would be the next day, [Saturday] February 21, 2015."

disclosure that it had increased its working interest in the Shenandoah project from 30% to 33%.[42]

In this section, I take Mr. Steinholt's alleged inflation as given, and ask whether the Named Defendants would have benefited from the $1.75 or $1.92 per share inflation from February 23, 2015 through May 2, 2017 in the form of increased realized compensation. I focus on the components of compensation that are directly or indirectly affected by Anadarko's stock price.

5.1. Annual Bonuses (AIP)

As discussed in Section 3.2, bonuses under Anadarko's AIP are based on a variety of operational, financial, and safety performance measures approved by the Committee each year. In 2015 (and only in 2015), the Committee introduced relative TSR as one of the performance measures, making up 5% of the overall AIP Performance Score. Like the PU Plan, the TSR component in the AIP plan was based on Anadarko's TSR among its cohort (Anadarko plus its eleven peers). The contribution to the AIP Performance Score is summarized in Table 5. If Anadarko's 2015 TSR ranked first among the cohort, for example, the AIP Performance Score would be 13.75 percentage points higher than if it ranked twelfth.

Table 6 shows the 2015 TSR performance for Anadarko and its eleven peer firms, where TSR is based on the 30-day average stock price prior to the beginning and at the end of the year, plus dividends.[43] As shown in the table, Anadarko's TSR for 2015 was -33.6%, which ranked ninth among the cohort, earning the Anadarko executives 2.5% towards their AIP

---

42 Steinholt Report, ¶ 106 and footnote 129, showing that $1.75 equals $1.92 × (.30/.33). Mr. Steinholt does not explain why Anadarko would increase its working interest in the project if the top executives believed that Anadarko was not or was not likely to be commercially viable.

43 The peer group is identified in Anadarko's DEF 14A (Proxy) Statement filed March 18, 2016, p. 40.

Performance Score.[44] Absent the alleged inflation (*i.e.*, reducing Anadarko's closing price by $1.75), Anadarko's TSR for 2015 would have been -35.7%, which would still have been ranked ninth in the twelve-firm cohort.[45] Therefore, as evident from Table 6, the alleged inflation affected neither the AIP Performance Score nor the ultimate AIP payout. In any case, and as described in Table 3, the Committee ultimately used its discretion to reduce the 2015 AIP Performance Score from 196.5% to 110.0%.

Overall, it is my opinion that the Named Defendants would not have benefited from the alleged inflation through their AIP payouts during the Class Period, and in fact the AIP payouts would have remained the same under the alleged inflation (the "Steinholt Stock Prices").

5.2. Restricted Stock Units (RSUs)

As discussed above in Section 3.3, the number of RSUs granted to each Named Defendant is determined by multiplying the Target RSU Award and dividing by the stock price on the grant date.[46] Since the dollar value of the grant is fixed, lower grant-date stock prices imply more RSUs, while higher grant-date stock prices imply fewer RSUs. The Anadarko Named Defendants received two RSU grants during the Class Period. Mr. Steinholt contends that the October 26, 2015 grant was made when the $69.00 stock price was artificially inflated by $1.75, while the November 10, 2016 grant was made when the $61.87 stock price was artificially inflated by $1.92.

---

44 Similar to the PU Plan, TSR for the AIP is measured based on 30-day average stock prices at the end of the year ($53.54) and the beginning of the year ($82.20). Dividends during the year totaled $1.08, yielding a TSR of ($53.54 + $1.08- $82.20)/$82.20 = -33.6%.

45 Absent the alleged inflation, Anadarko's TRS would be ($53.54 - $1.75 + $1.08- $82.20)/$82.20 = -35.68%.

46 The Target RSU Award is calculated as the Target Equity Award multiplied by the Target RSU Percentage (which was 25% for all Named Defendants between 2014 and 2018; *see* Table 1).

Table 7 compares the RSU awards made at the actual grant-date stock prices to the RSU awards that would have been made absent the Steinholt Stock Price.[47] As shown in the table, the Named Defendants in total would have received 2,046 *more* RSUs under the Steinholt Stock Price in the October 2015 grant, and would have received 2,336 *more* RSUs under the Steinholt Stock Price in the November 2016 grant.

Table 8 provides my analysis of the value upon vesting of the additional RSUs that would have been granted absent the alleged inflation. To be conservative, I exclude dividend equivalents that would have been paid on these RSUs as of vesting. The values for RSUs vesting on October 26, 2016 are based on the Steinholt Stock Price (*i.e.*, the actual $60.90 closing price minus $1.92) and the value for RSUs vesting on August 8, 2019 are based on the $72.50 per share merger consideration; all other values are based on Anadarko closing stock prices on vesting dates.[48] The vesting dates for Mr. Walker and Mr. Gwin are straightforward, since they continued as Section 16 reporting employees until the Occidental acquisition. The vesting dates for Mr. Leyendecker are also straightforward, since all unvested RSUs vested upon his departure in June 2018.[49] For Mr. Daniels, I assume his unvested RSUs were forfeited upon his voluntary retirement.[50]

As shown in Table 8, the additional 4,382 RSUs earned by the Named Defendants in the absence of alleged inflation would have an aggregate vesting value of $241,098 (not counting dividend equivalents). Therefore, it is my opinion that the Named Defendants did not benefit

---

[47] The "RSU Award at Actual Stock Price" differs slightly from the actual grant reported in Anadarko's Proxy Statement due to rounding and (in some cases) differing reliance on ASC 718 accounting values.

[48] Upon the merger, each RSU was converted into $59.00 in cash plus the cash value of .2934 shares of Occidental common stock on the day prior to closing ($46.00 on August 7, 2019), or $72.50 in total. *See* Anadarko Petroleum Corporation DEFM14A Statement filed July 11, 2019 ("Merger Proxy"), p. 80.

[49] *See* Ernest A. Leyendecker III Form 4 filed June 5, 2018.

[50] *See* APC-00780428 at 444.

from the alleged inflation through their RSU grants during the Class Period, and in fact would have been better off under the Steinholt Stock Prices.

5.3. Non-Qualified Stock Options (NQSOs)

As discussed above in Section 3.4, the number of NQSOs granted to each Named Defendant is determined by dividing the Target NQSO Award by the per-unit value for each option. Since the dollar value of the NQSO Award is fixed, lower grant-date stock prices (as alleged by Mr. Steinholt) imply that more options will be granted at lower exercise prices. Thus, the Named Defendants would have been better off under the Steinholt Stock Prices.

The Named Defendants received stock options in October 2015 at an exercise price of $69.00 per share, and in November 2016 at an exercise price of $61.87 per share. Table 9 compares the option grants actually made during the Class Period to those that would have been made under the Steinholt Stock Prices. Since the value of an at-the-money option is proportional to the stock price,[51] the option value at the Steinholt Stock Price is calculated as the option value at the actual price multiplied by the ratio of the Steinholt Stock Price to the actual stock price.[52] The "NQSO Award at Steinholt Stock Price" is then calculated as the Target NQSO Award divided by the Option Value at Steinholt Stock Price.

As shown in Table 9, the Named Defendants received 311,217 options at an exercise price of $69.00 per share in October 2015, and 222,229 options at an exercise price of $61.87 per share in November 2016. Absent the alleged inflation, the Named Defendants would have received 319,316 options at an exercise price of $67.25 per share in October 2015 (+8,099

---

[51] *See* Murphy, Kevin J., "Corporate Performance and Managerial Remuneration: An Empirical Analysis," *Journal of Accounting and Economics*, Vol. 7 (1985), Eq. (1) on p. 19.

[52] Using Mr. Walker's 2015 grant as an example, $17.948 × ($67.25/$69.00) = $17.493.

options), and 229,346 options at an exercise price of $59.95 per share in November 2016 (+7,117 options).

Table 10 compares the ultimate gains-upon-exercise for the Named Defendants with and without the assumed inflation. Quantifying the ultimate gains of the options absent the alleged inflation for Mr. Walker and Mr. Gwin is straightforward, since SEC disclosures confirm they held the options from the 2015 and 2016 grants until August 8, 2019, when they were effectively exercised for the merger consideration of $72.50/share.[53] As shown in Table 10, Mr. Walker's options would have been worth an additional $609,017 absent the alleged inflation, while Mr. Gwin's options would have been worth an additional $244,186.

For Mr. Daniels, I assume that (1) his unvested options were forfeited upon his retirement in December 2016; (2) he was allowed 36 months to exercise his vested options; and (3) he indeed held his exercisable options until the Occidental transaction in August 2019.[54] One third of Mr. Daniels' 2015 NQSO grant of 63,393 options (as reported) or 65,043 (absent the alleged inflation) would have been vested upon his retirement. As shown in Table 10, Mr. Daniels' options would have been worth an additional $39,867 absent the alleged inflation.

Similarly for Mr. Leyendecker, I assume that (1) his unvested options were forfeited upon his retirement in June 2018; (2) he was allowed 36 months to exercise his vested options; and (3) he indeed held his exercisable options until the Occidental transaction.[55] Two thirds of

---

[53] Upon the merger, each in-the-money Anadarko stock option was cashed out based on the cash value of the merger consideration ($59.00 in cash per-share plus the cash value of .2934 shares of Occidental common stock on the day prior to closing, or $13.50). *See* Merger Proxy, p. 79.

[54] Termination provisions under voluntary resignation (including retirement) provides for unvested options to be forfeited, and vested options (if retirement eligible) to have 36 months to exercise. *See* APC-00779578 at 634. Mr. Daniels could have exercised his options prior to the Occidental transaction at prices higher or lower than the merger consideration.

[55] *See* note 54, *supra*. The Merger Proxy confirms that Mr. Leyendecker's vested options were cashed out in the transaction. *See* Merger Proxy, p. 80.

Mr. Leyendecker's 2015 NQSO grant of 31,209 options (as reported) or 32,021 (absent the alleged inflation) would have been vested upon his retirement, and one-third of his 2016 grant of 30,780 options (as reported) or 31,766 (absent alleged inflation) would have been vested. As shown in Table 10, Mr. Leyendecker's options would have been worth an additional $63,081 absent the alleged inflation.

In aggregate across grants and executives, Table 10 shows that the options granted to the Named Defendants during the Class Period would have been worth an additional $956,152 absent the alleged inflation. Therefore, it is my opinion that the Named Defendants did not benefit from the alleged inflation through their NQSO grants during the Class Period, and in fact would have been better off under the Steinholt Stock Prices.

5.4. Performance Units (PUs)

As discussed above in Section 3.5, Anadarko's PU plan is a cash plan where the payoffs are based on both Anadarko's stock price and its TSR-ranking compared to eleven industry peers. The payout from the PU plans is based on the number of shares earned (determined by the relative TSR) and Anadarko's closing stock price when the units are cashed out (generally Anadarko's closing price on the 15th business day after the Performance Period).[56] Several PU grants are potentially affected by the alleged inflation in Anadarko stock prices, including:

1. *Grants made prior to the Class Period where the Performance Period ends during the Class Period.* In these instances, the alleged inflation artificially raises Anadarko's TSR, which could artificially raise its ranking among its cohort and, thus, increase the number of units earned. In addition, the stock price when the PUs are converted to cash would also be artificially inflated, leading to larger cash payouts;
2. *Grants made during the Class Period where the Performance Period ends after the Class Period.* Since the target number of PUs granted is determined by multiplying the fixed-dollar Target PU Award and dividing by the PU per-unit value (which moves with the

[56] *See, e.g.*, APC-00790250 at 264-265. Formally, the value is calculated based on Anadarko's stock price on the date the Committee certifies the performance results and approves the payouts.

stock price) on the grant date,[57] the target number of PUs would be higher absent the alleged inflation. In addition, the alleged inflation artificially lowers Anadarko's TSR which could artificially lower its ranking among its cohort and, thus, decrease the number of units earned and lead to lower cash payments.

The Named Defendants unambiguously gain from the alleged inflation for PU grants in Group 1 above, and unambiguously lose from the alleged inflation for PU grants in Group 2.[58] Whether the Named Defendants would financially benefit from the alleged inflation therefore depends on the relative gains and losses.

Table 11 identifies the PU Grants potentially impacted by the alleged inflation. The table shows the Grant Date, the Performance Period, the TSR rank as reported in the proxies, the TSR rank in the absence of the alleged inflation, the alleged inflation in the final stock price used to determine cash payouts (*i.e.*, \$1.75 or \$1.92 for grants with Performance Periods ending during the Class Period) and the difference in the Award Value earned in the absence of the alleged inflation. The number in parentheses next to the rank is the payout percentage from Table 4.

The top panel (Group 1) shows that the absence of the alleged inflation would not change Anadarko's TSR ranking among its peers in any grant except for the 2013 grant with the two-year Performance Period, where Anadarko's rank absent the alleged inflation would have slipped from #7 to #8 and its payout percentage would have fallen from 92% of target to 72% of target. The four Named Defendants had a combined November 2013 target PU award of 85,112 PUs, to be split evenly between grants with two-year and three-year Performance

[57] The Target PU Award is calculated as the Target Equity Award multiplied by the Target PU Percentage (which was 40% for Mr. Leyendecker in 2014 and 2015 and 50% in 2016 and 2017, and 50% for all other Named Defendants between 2014 and 2018; *see* Table 1).

[58] Note that I am excluding grants made before that Class Period where the Performance Period ends after the Class Period (*e.g.*, the November 2014 grant) since the alleged inflation would not affect such grants; I also need not consider grants with Performance Periods either entirely before or entirely after the Class Period. Also, there were no grants where the Performance Period both began and ended during the Class Period.

Periods.[59] The Named Defendants earned 39,151.5 PUs from the two-year portion of this grant, worth approximately $1,389,095 based on the $35.48 stock price on the payout date.[60] However, in the absence of the alleged inflation, they would have only received 30,640.3 PUs (72% of target rather than 92%), and the cash-out value would be based on the Steinholt Stock Price of $33.73 (i.e., the closing price less $1.75), yielding $1,033,497. Thus, as shown in Table 11, the Named Defendants would have been $355,598 *worse off* with respect to this PU grant in the absence of the alleged inflation.

For the other PU grants in Group 1 in Table 11, the alleged inflation would not affect the number of PUs earned, but would rather affect only the settlement price when cashed out. In the absence of inflation, grants with Performance Periods ending in 2015 would have a settlement price $1.75 lower, while grants with Performance Periods ending in 2016 would have a settlement price $1.92 lower. The aggregate difference in payouts for the Named Defendants in the absence of inflation is therefore calculated as the aggregate PU target multiplied by the payout percentage (in parentheses in Table 11) multiplied by the inflation at payout (*i.e.*, $1.75 or $1.92).[61]

For the Group 2 grants in Table 11, the ultimate award would potentially change absent the alleged inflation for two reasons: (1) the reduced Steinholt Stock Price on the grant date would increase the number of target PUs granted; and (2) the reduced Steinholt Stock Price on

---

59 Target PU grants for 2013 for Mr. Walker, Mr. Gwin, and Mr. Daniels are reported in Anadarko Petroleum Corporation DEF 14A (Proxy) Statement filed March 21, 2014, p. 48. *See* APC-00784847 for Mr. Leyendecker's target PU 2013 grant.

60 That is, 50% × (81,112) × 92% = 39,151.5 PUs, multiplied by Anadarko's closing stock price of $35.48 on the January 22, 2016 settlement date.

61 Target PU grants for Mr. Walker, Mr. Gwin, and Mr. Daniels are reported in Anadarko Petroleum Corporation DEF 14A (Proxy) Statements filed March 25, 2013 (p. 51) and March 21, 2014 (p. 48). *See* APC-00784847 for Mr. Leyendecker's target PU 2013 grant. Mr. Leyendecker's 2012 PU Target is inferred from the PUs vesting in 2015 (APC-00784868 at 881) less the number of PUs vesting in 2015 from the 2013 PU grant (APC-00784868 at 883).

the grant date would increase Anadarko's TSR over the Performance Period. For (1), I estimate that the Target 2015 PU grant for the Named Defendants would have increased from 149,384 to 153,126 PUs, while the Target 2016 PU grant would have increased from 129,091 to 132,716 PUs.[62] For (2), I find that starting with the Steinholt Stock Prices increases Anadarko's 3-year TSR for the October 2015 grant from -3.60% to -0.32%, which increases Anadarko's rank among its cohort from 8th to 7th, which in turn increases the ultimate award from 60% of Target to 80% of Target.

The Named Defendants earned 75,869 units from October 2015 grant, worth approximately $3,480,861 based on the $45.88 stock price on the payout date.[63] However, in the absence of the alleged inflation, they would have received 103,692 PUs, yielding $4,757,393.[64] The Named Defendants would therefore have received cash payments of $1,276,531 more from the October 2015 grant.

As per the Occidental Merger Agreement, unvested PUs held as the transaction were deemed to be earned at 200% of target and cashed out at a fixed price of $76.00 per PU.[65] Accordingly, the Named Defendants earned 239,308.7 PUs from the November 2016 grant, cashed out at $18,187,459. Absent the alleged inflation, the Named Defendants would have earned 246,029.5 PUs with a cash-out value of $18,698,239. Thus, absent the alleged inflation,

---

[62] I assume that the value per Performance Unit is equal to the value implied in the Proxy Statements (Total PU Value divided by target units) less the alleged inflation (*i.e.*, $1.75 for Class Period grants before July 27, 2016 and $1.92 after).

[63] Target 2015 PU awards for Mr. Walker, Mr. Gwin, Mr. Daniels, and Mr. Leyendecker were 77,548, 31,096, 31,795, and 8,945 respectively (Anadarko Petroleum Corporation DEF 14A Statement filed March 23, 2018; APC-0078847). Upon certification on January 19, 2019 (when Anadarko's stock price closed at $45.88), Mr. Walker and Mr. Gwin received 60% of their target, Mr. Daniels received 60% of one-third of his target (since he served only 12 of the 36-month of the Performance Period), and Mr. Leyendecker received 60% of 29/36th (since he served only 29 of the 36-month of the Performance Period).

[64] As described in the prior footnote, the award value assumes the proration of Mr. Daniels' and Mr. Leyendecker's award.

[65] *See* Merger Proxy, p. 81.

the Named Defendants would have received cash payments of $510,781 more from the November 2016 grant.

Table 12 summarizes the change in PU payouts to each Named Defendant in the absence of the alleged inflation. All Defendants would have been better off under the Steinholt Stock Prices than the actual prices. Therefore, it is my opinion that the Named Defendants did not benefit from the alleged inflation through their PU grants.

5.5. Summary

Table 13 summarizes my findings of how the Named Defendants compensation would be impacted absent the alleged inflation in Anadarko stock prices. Overall, I find that each Named Defendant would have been better off financially if Anadarko's stock price had been $1.75 per share lower from February 23, 2015 to July 26, 2016, and $1.92 per share lower from July 27, 2016 to May 2, 2017. Collectively, the Named Defendants would have realized nearly $2.5 million more absent the alleged inflation. It is therefore my opinion that the Named Defendants did not benefit financially from the alleged inflation through increased compensation.

6. Did Named Defendants benefit financially from the alleged stock-price inflation through their trading activities?

Trading by executives that is "out of line with prior trading practices or at times calculated to maximize personal profit" may be indicia of scienter.[66] For example, an insider, aware of material inside information about their company's stock price, may sell shares when

[66] *Abrams v. Baker Hughes Inc.,* 292 F.3d 424, 435 (5th Cir. 2002).

they know the market price is too high, and purchase shares when they know the market price is too low.[67] Plaintiffs and Mr. Steinholt allege that, beginning on February 20, 2015, Defendants "defrauded investors by various means and methods concerning the commercial viability and producible resource size of Shenandoah", allegedly inflating Anadarko's stock until the alleged truth was revealed on May 2, 2017.[68]

Under Plaintiffs' theory of the case, we would expect to see that the Named Defendants actively sold Anadarko shares during the Class Period, by selling shares owned directly and shares acquired through the exercise of stock options or the vesting of RSUs. In fact, as I document in this section, the Named Defendants did not sell any direct shares during the Class Period, retained all shares from vesting RSUs (except for those withheld by Anadarko for tax purposes), and generally retained all shares acquired through option exercises (except for shares used to pay the exercise price and to satisfy tax obligations, including shares withheld by Anadarko).[69]

6.1. Mr. Walker

As shown in Figure 1, Mr. Walker did not sell shares or exercise options during the Class Period. When his RSUs vested in May 2015, November 2015, October 2016, and November 2016 he transferred only the shares required to satisfy tax obligations, retaining the remaining

[67] There is a robust academic literature analyzing how informed insider trading allows insiders to profit from their information advantage (*e.g.*, Seyhun (1986); Fishman and Hagerty (1992); Bettis et al. (2000); Jagolinzer et al. (2011); Agrawal and Nasser (2012); Kraft et al. (2014); Lee et al. (2014); Agrawal and Cooper (2015); Aitken et al. (2015); Hillier et al. (2015)).

[68] Motion for Class Certification and Memorandum of Law in Support, ECF No. 86, dated October 1, 2021, at 1; Deposition of Bjorn I. Steinholt, CFA dated December 21, 2022, at 51:1-21.

[69] As noted in Section 4.3, the only exception was options/shares exercised/sold by Mr. Daniels at his ex-wife's request and pursuant to a divorce decree.

shares and dividend equivalents.[70] Overall, there is no evidence of suspicious trading activity by Mr. Walker during the Class Period. The fact that Mr. Walker did not sell shares during the Class Period is not explained by Anadarko's Stock Ownership Guidelines since, as is clear from Figure 2, he was in full compliance with the guidelines before, during, and after the Class Period. Indeed, his direct shareholdings increased by 45,632 shares during the Class Period, in addition to an increase of 8,155 RSUs and 218,576 NQSOs.

6.2. Mr. Gwin

As shown in Figure 3, Mr. Gwin exercised options at two points during the Class Period, but did not sell the shares acquired during the Class Period. On October 7, 2015, he exercised 78,600 options set to expire on November 4, 2015, retaining 22,408 shares after Anadarko withheld 56,192 shares to finance the exercise price and taxes.[71] He did not sell the shares acquired upon exercise during the Class Period, and therefore could not have taken advantage of any alleged inflation. Mr. Gwin also exercised options on February 29, 2016, exercising 66,200 options set to expire the following day. Again, Mr. Gwin retained all net shares after those withheld by Anadarko to pay exercise prices and taxes.[72] Similarly, when his RSUs vested in November 2015, October 2016, and November 2016 he retained all net shares after those withheld by Anadarko to satisfy tax obligations.[73] Mr. Gwin had no other stock transactions during the Class Period.

---

[70] *See* R. A. Walker Form 4s filed May 19, 2015, November 9, 2015, October 27, 2016, and November 7, 2016. The shares withheld by Anadarko for tax purposes are noted by the Transaction Code "F" in Mr. Walker's Form 4s.

[71] Robert G. Gwin Form 4 filed October 9, 2015.

[72] Robert G. Gwin Form 4 filed March 2, 2016.

[73] Robert G. Gwin Form 4s filed November 9, 2015, October 27, 2016, and November 7, 2016. The shares withheld by Anadarko for tax purposes are noted by the Transaction Code "F" in Mr. Gwin's Form 4s.

Overall, there is no evidence of suspicious trading activity by Mr. Gwin during the Class Period. The fact that Mr. Gwin did not sell shares during the Class Period is not explained by Anadarko's Stock Ownership Guidelines since, as is clear from Figure 4, he was in full compliance with the guidelines before, during, and after the Class Period. Indeed, his holdings held directly and in his 401(k) increased by 41,918 shares during the Class Period, in addition to an increase of 6,438 RSUs and 69,588 NQSOs.

6.3. Mr. Daniels

As shown in Figure 5, Mr. Daniels exercised options at two points during the Class Period. On March 20, 2015, Mr. Daniels exercised 38,449 options from his 2008 and 2009 grants, immediately selling all the shares acquired. In his Form 4 filed on March 24, Mr. Daniels explains that he "had previously transferred the economic interest in these stock options to his ex-wife pursuant to a divorce decree and has exercised/sold these options/shares at her request."[74] In my opinion, Mr. Daniels did not personally benefit from this exercise during the Class Period.[75]

Mr. Daniels also exercised 30,841 options on October 14-15, 2015, retaining all shares net of those withheld by Anadarko to pay the exercise price and taxes.[76] He sold no other shares during the Class Period prior to his December 2016 retirement, and retained all shares (net of those withheld by Anadarko to satisfy tax obligations) when his RSUs vested in November 2015, October 2016, and November 2016.[77]

---

[74] Robert P. Daniels Form 4 filed March 24, 2015.

[75] Mr. Daniels' ex-wife may have benefited by as much as $65,536 before taxes (37,449 shares × $1.75 alleged inflation) more than she would have received absent the alleged inflation.

[76] Robert P. Daniels Form 4 filed October 16, 2015. The shares withheld by Anadarko for tax purposes are noted by the Transaction Code "F" in Mr. Daniels' Form 4.

[77] Robert P. Daniels Form 4s filed November 9, 2015, October 27, 2016, and November 7, 2016. The shares withheld by Anadarko for tax purposes are noted by the Transaction Code "F" in Mr. Daniels' Form 4s.

Overall, there is no evidence of suspicious trading activity by Mr. Daniels from the beginning of the Class Period through his December 2016 retirement.[78] The fact that Mr. Daniels did not sell shares during the Class Period (beyond those related to his divorce decree) is not explained by Anadarko's Stock Ownership Guidelines since, as is clear from Figure 6, he was in full compliance with the guidelines before, during, and after the Class Period. Indeed, his holdings held directly, in his family's LP, and in his 401(k) increased by 26,335 shares during the Class Period.[79]

6.4. Mr. Leyendecker

As shown in Figure 7, Mr. Leyendecker did not exercise any options or sell any shares during the Class Period. When his RSUs vested in November 2015, October 2016, and November 2016, he retained all shares and dividend equivalents except for the shares withheld by Anadarko to satisfy tax obligations.[80] As discussed in Section 4.4, Mr. Leyendecker had three years to increase his holdings to $1,725,000 (*i.e.*, three times his new $575,000 Base Salary) following his promotion to EVP in August 2016. As shown in Figure 8, Mr. Leyendecker was in compliance with Anadarko's Stock Ownership Guidelines at all times, and in fact reached $1,725,000 in holdings more than two-and-a-half years before required

---

[78] I understand that a whistleblower letter from a former Anadarko employee, Lea Frye, asserts that a May 21, 2014 transaction in stock by Mr. Daniels, which she characterizes as a sale of "61,379 shares of his Anadarko stock (transaction of approximately $6.143 million)" might constitute insider trading (Exhibit 355 to Deposition of Lea Frye dated October 7, 2022). As noted in Section 4.3 above, Mr. Daniels indeed exercised 51,379 options and sold the shares acquired on this day, and additionally sold 10,000 Anadarko shares held directly (*see* Robert P. Daniels Form 4 filed May 22, 2014). These transactions predate the Class Period, prior to which it is not alleged that Anadarko's share price was inflated. Notably, Ms. Frye traded in Anadarko stock within a few days of Daniels' trade, asserting that she did not possess any knowledge which would be considered insider information regarding current Anadarko activities (Deposition of Lea Frye dated October 7, 2022, at 236:23-240:22; *see also* Exhibit 364 to that Deposition).

[79] Mr. Daniels' RSUs and NQSOs declined near his retirement, primarily reflecting that (because of his pending retirement) he did not receive grants of RSUs and NQSOs in November 2016.

[80] Ernest A. Leyendecker III Form 4s filed October 27, 2016, and November 7, 2016. The shares withheld by Anadarko for tax purposes are noted by the Transaction Code "F" in Mr. Leyendecker's Form 4s

under the Guidelines. Therefore, his "lack" of trading over this period is not explained by Anadarko's Stock Ownership Guidelines.

Overall, there is no evidence of suspicious trading activity by Mr. Leyendecker during the Class Period. The fact that Mr. Leyendecker did not sell shares during the Class Period is not explained by Anadarko's Stock Ownership Guidelines since, as is clear from Figure 8, he was in compliance with the guidelines before, during, and after the Class Period.[81] Indeed, his direct holdings increased by 5,574 shares during the Class Period, in addition to an increase of 6,777 RSUs and 53,161 NQSOs.

6.5. Summary

In summary, there is no evidence of suspicious trading by the Named Defendants during the Class Period. Indeed, rather than actively selling shares to exploit the alleged inflation in Anadarko stock, the Named Defendants kept reinvesting vested RSUs and exercised options into Anadarko, and collectively and individually *increased* their holdings of Anadarko shares. Notably, the Named Defendants were among the shareholders who lost money when Anadarko's stock prices fell by $4.33 on May 3, 2017. In particular, Mr. Walker's 265,418 shares and 81,495 RSUs fell by $1,502,142 on May 3, Mr. Gwin's 112,476 shares and 32,659 RSUs fell by $628,435, and Mr. Leyendecker's 17,441 shares and 15,304 RSUs fell by $141,786.

Finally, in addition to analyzing the trading activity of the Named Defendants, it is relevant to also analyze the trading-related activity of their employer. The Complaint alleges

---

[81] While Mr. Leyendecker was technically in compliance with the Stock Ownership Guidelines between August 2016 and October 2016 (since he had three years to increase his holdings to 3 times his base salary), he was nonetheless prohibited during this period under the Guidelines from selling shares upon the exercise of options or the vesting of RSUs. *See* Anadarko Petroleum Corporation DEF 14A (Proxy) Statement filed March 17, 2017, p. 56.

that the Named Defendants led Anadarko's day-to-day operations, "monitored and/or oversaw the Shenandoah project" and "were the persons with ultimate responsibility for directing and managing the Company's business, operations, and communications to investors."[82] If Plaintiffs' allegations as to responsibilities are correct, the Named Defendants were logically involved in the July 26, 2016 decision to increase Anadarko's working interest in the Shenandoah project from 30% to 33%.[83] If Anadarko's stock was indeed inflated as suggested by Mr. Steinholt, this increased working interest would negatively impact the post-Class Period value of the Named Defendants' stock holdings and the vesting value of their equity-based compensation.

7. Did the alleged misstatement with respect to Shen-3 impact bonus awards to Anadarko management?

Mr. Regan opines that the $64 million in Shen-3 expenses should have been expensed by the fourth quarter of 2014 (and reported in Anadarko's 10-K for fiscal year 2014) instead of in the third quarter of 2016 (as actually reported in Anadarko's 10-Q filed on October 31, 2016) once Anadarko concluded it was a dry hole.[84] Mr. Regan further argues that even "quantitatively small misstatements" can be considered material if "the misstatement has the effect of increasing management's compensation".[85] He then contends that:

> *"The Shen-3 results and the associated reduction in resource estimates was further significant considering that management's bonus[es] were affected by performance goals that included consideration of MMBOE sales and related*

---

[82] Complaint, ¶ 149(a).
[83] Steinholt Report, ¶ 106.
[84] Regan Report, ¶ 11(a).
[85] Regan Report, ¶ 77 (c).

> *reserves (representing an aggregate of performance goal weighting factor ranging from 42% – 50%). Although the Shenandoah basin project, including Shen-3, was exploratory in nature and in fact, a dry hole, the failure to appropriately expense Shen-3 as a dry hole expense indicated an increased possibility that the well could be used as a producing well to extract oil resources that could impact management performance goals and related compensation in the future.”*[86]

Mr. Regan’s emphasis on “performance goals that included consideration of MMBOE sales and related reserves” in the above quote seems irrelevant, since Anadarko never booked any reserves in connection with the Shen-3 well or the Shenandoah prospect more broadly.[87] Moreover, as discussed in Section 3.2 and as evident from Table 2, there are no AIP performance measures related to unproved reserves or resource targets.[88] In addition, the Committee did not make any Individual Performance adjustments to AIP bonuses from 2014--2018 related to unproved reserves (and in fact did not make any individual adjustments at all).

Beyond making some general allusions to Anadarko’s management bonus plans, Mr. Regan provides no analysis of how and to what extent bonuses might be impacted by the decision of when to expense drilling costs associated with Shen-3. Indeed, during his deposition Mr. Regan admitted that he did not know whether expensing Shen-3 or not would impact bonus awards.[89] Ultimately, analyzing these impacts requires a nuanced understanding of how such expenses effect AIP performance measures and subsequent bonuses.

---

[86] Regan Report, ¶ 86.

[87] *See* Deposition of Charles F. Oudin, III dated June 30, 2022, at 243:7-11.

[88] *See* also Deposition of Robert P. Daniels dated October 13, 2022, at 40:19-42:18.

[89] *See* Deposition of Paul Regan dated January 20, 2023, at 129:4-23.

As shown in Table 2, AIP bonuses in 2014 were based on sales volumes and reserve additions (weighted 50%), capital expenditures (weighted 20%), and a safety measure (weighted 10%). None of these measures is directly impacted by exploratory drilling expenses. Moreover, the fifth measure, EBITDAX/BOE (weighted 20%), is defined as "earnings before interest, taxes, depreciation, depletion, amortization, and *exploration expenses* divided by sales volume for the year" (emphasis added).[90] Investopedia defines the exploration expense component of EBITDAX as follows:

> *"Exploration costs are the costs an oil or gas company incurs while searching for oil or gas to drill. Exploration costs include the cost of researching appropriate places to drill and the cost of actually drilling. Exploration costs are recognized in the financial statements as exploration, abandonment, and dry hole costs."*[91]

Mr. Regan opines that the $64 million in Shen-3 expenses should have been expensed by the fourth quarter of 2014. While such expensing would have reduced Anadarko's reported net earnings, it would not have reduced Anadarko's EBITDAX and therefore would not have reduced 2014 bonuses under the AIP.

In contrast, by 2016 Anadarko had introduced "Controllable Cash Costs" as an AIP performance measure with a 25% weight (*see* Table 2).[92] Notably, Controllable Cash Costs includes suspended exploratory well costs that are "subsequently reclassified to exploration expense for accounting purposes."[93] If Anadarko had expensed the $64 million drilling costs

---

[90] Anadarko Petroleum Corporation DEF 14A (Proxy) Statement filed March 23, 2015, p. 47.

[91] https://www.investopedia.com/terms/e/ebitdax.asp, accessed on January 23, 2023.

[92] Anadarko Petroleum Corporation DEF 14A (Proxy) Statement filed March 17, 2017, p. 41.

[93] Anadarko Petroleum Corporation DEF 14A (Proxy) Statement filed March 17, 2017, p. 43.

for Shen-3 in 2014 rather than 2016, its Controllable Cash Costs for 2016 would be reduced by $64 million, or $0.22 per BOE.[94]

As reported in its 2017 Proxy Statement, Anadarko's Target Controllable Cash Costs (after mid-year adjustments for certain divestitures) was $13.56/BOE, which at target would contribute 25% to the AIP Performance Score.[95] Anadarko's reported 2016 Controllable Cash Costs was $12.70/BOE, resulting in a contribution of 44.8% to the final AIP Performance Score.[96] Internal documents confirm that the relation between Controllable Cash Costs per BOE and the 2016 AIP contribution is linear, up to a maximum contribution to the final AIP Performance Score of 50% (*i.e.*, 200% of 25%).[97] This linearity allows me to determine that a $0.22 reduction in the Cash Cost per BOE corresponds to an increase in this component's contribution to the AIP Performance Score from 44.8% to 49.9%, or a difference of 5.1%.[98] This 5.1% increase in the AIP Performance Score (caused by shifting the $64 million in expenses to 2014) would have increased Mr. Walker's 2016 AIP bonus by $86,190, Mr. Gwin's bonus by $36,338, and Mr. Leyendecker's by $20,579.[99]

---

94 Calculation based on 2016 sales volume of 290 MMBOE (*see* Anadarko Petroleum Corporation Form 10-K filed February 15, 2017, p. 19).

95 Anadarko Petroleum Corporation DEF 14A (Proxy) Statement filed March 17, 2017, p. 42.

96 Anadarko Petroleum Corporation DEF 14A (Proxy) Statement filed March 17, 2017, p. 42.

97 APC-00782204 at 212.

98 In particular, if a $0.86 decrease in Controllable Cash Costs/BOE (from $13.56 to $12.70) corresponds to an increase in payout contribution by 19.8%, we can derive that each dollar reduction in Controllable Cash Costs/BOE increases payout contribution by 23 percentage points. Multiplying 23% by $0.22 suggest an increase in the AIP Performance Score of 5.1 percentage points.

99 Results based on increasing 2016 AIP awards from 158% of target to 163.1% of target (Anadarko Petroleum Corporation DEF 14A (Proxy) Statement filed March 17, 2017, pp. 43). The Committee determined that Mr. Daniels was not eligible for a 2016 AIP payout, since his retirement date preceded the date of the actual payout (*see* APC-00787898 at 906).

To summarize, it is my opinion that expensing Shen-3 drilling expenses in 2014 rather than 2016—as proposed by Mr. Regan—would have not changed 2014 AIP bonuses for the Named Defendants, but would have significantly increased their 2016 AIP bonuses.

8. Did the alleged inflation increase the payments to the Named Defendants in connection with the August 2019 acquisition by Occidental?

In connection with the Occidental acquisition in August 2019, several departing Anadarko executives (including Mr. Walker and Mr. Gwin) became eligible for certain benefits, including:

- Conversion of Anadarko RSU awards (including dividend equivalents) into equivalent Occidental restricted stock/cash unit awards, vesting according to their original schedule;[100]
- Immediate vesting and cash-out of all outstanding Anadarko stock options, at the merger consideration price of about $72.50;[101]
- Each Anadarko PU award immediately vested and converted into the right to receive cash equal to 200% of the target award multiplied by $76/unit.[102]

In addition, upon their departure within three years following the acquisition, Mr. Walker and Mr. Gwin would each receive a multiple of the sum of their respective salary and bonus (2.5 times for Mr. Walker, and 2.9 times for Mr. Gwin), continuation of medical and other benefits for three years, outplacement services, and service-credits related to Anadarko's retirement and savings plans.

---

[100] *See* Merger Proxy, pp. 12, 80.

[101] *See* Merger Proxy, pp. 12, 79. As discussed before, the merger consideration was $59.00 in cash plus the cash value of .2934 shares of Occidental common stock on the day prior to closing ($46.00 on August 7, 2019), or about $72.50 in total.

[102] *See* Merger Proxy, pp. 12, 81.

In the Complaint, Plaintiffs repeatedly emphasize so-called "golden parachute" payments received by Anadarko executives in connection with the Occidental acquisition.[103] Plaintiffs provide no account of how an alleged fraud that was revealed in May 2017 could have impacted compensation in relation to Occidental's late 2019 acquisition of Anadarko.

As discussed at length in Section 5, because of the fixed dollar equity grants, the Named Defendants would have received more RSUs, more PUs, and more NQSOs during the Class Period absent the alleged inflation. For continuing Named Defendants Walker and Gwin, one third of the additional RSUs granted in November 2016 would still be unvested as of the Occidental transaction, as would all of the November 2016 PUs (since the relevant Performance Period was set to end in December 2019, after the transaction). Similarly, unexercised stock options issued in October 2016 and November 2017 would remain outstanding upon the transaction.

Table 14 summarizes the additional amounts the Named Defendants *would* have received in connection with the Occidental acquisition absent the alleged inflation. The amounts are taken directly from Table 8 (RSUs), Table 10 (NQSOs), and Table 12 (PUs), and reflects the value of the additional equity at the $72.50 merger consideration (for RSUs and NQSOs) or $76.00 (for PUs). Across all pay components, I estimate that the Named Defendants would have realized approximately $1.5 million in additional payouts absent the alleged inflation.

In sum, the alleged inflation would continue to cost Named Defendants even in connection with the Occidental acquisition.

---

[103] *See, e.g.*, Complaint ¶¶ 5(s), 9, 150, and 156. Significantly, Mr. Daniels and Mr. Leyendecker had retired well before the acquisition, though Mr. Leyendecker still had outstanding Anadarko PUs and stock options that were cashed out in the transaction. *See* Merger Proxy, pp. 79-81. The foregoing discussion is accordingly limited to Mr. Walker and Mr. Gwin.

9. Author's Statement and Qualifications

I hold the Kenneth L. Trefftzs Chair in Finance at the University of Southern California Marshall School of Business. I have been a Full Professor of the Department of Finance and Business Economics at the USC Marshall School since 1995, and I currently serve as Department Chairman. I also hold a joint appointment in the USC School of Law (as Professor of Business, Economics and Law). I previously served as Department Chairman from 2003 to 2004, and as the Marshall School's Vice Dean of Faculty and Academic Affairs from 2004 to 2007. From 1991 to 1995, I was an Associate Professor of Business Administration at the Harvard Business School, and from 1983 to 1991, I was an Assistant and Associate Professor at the University of Rochester's William E. Simon Graduate School of Business Administration.

I received a Ph.D. in Economics from the University of Chicago in 1984, where my honors included a National Science Foundation Fellowship, a Milton Friedman Fund Fellowship, and a Social Science Foundation Dissertation Fellowship. I also have an M.A. in Economics from the University of Chicago, and a B.A. degree (summa cum laude) from the University of California, Los Angeles. I am a member of Phi Beta Kappa, the American Economic Association, and the American Finance Association. I am an associate editor of the *Journal of Financial Economics,* a former associate editor of the *Journal of Accounting and Economics* and the *Journal of Corporate Finance,* and I serve as referee to over thirty professional and academic journals. I am the former chairman of the Academic Research Committee of WorldAtWork (formerly the American Compensation Association). My curriculum vitae is attached at the end of this report.

I am a recognized expert on executive compensation, and I have written and published extensively on issues related to executive compensation, beginning with my 1984 dissertation. During 1992 and 1993, I conducted annual surveys of executive compensation practices in the 1,000 largest U.S. corporations. These surveys, sponsored by the United Shareholders Association, were used extensively by institutional investors and large shareholders in evaluating and comparing the effectiveness of compensation policies. I also advised the SEC in formulating its 1992 disclosure rules for top management pay, and I was a prominent member of the 1992 and 2003 National Association of Corporate Directors' Blue Ribbon Commissions on Executive Compensation, which issued reports calling for the overhaul of CEO pay practices. In 2009, I served as advisor to the U. S. Treasury's Special Master of Executive Compensation, charged with approving the level and structure of compensation for companies receiving "special assistance" from the U.S. government.

I have written more than fifty articles, cases, books, and book chapters relating to compensation and incentives in organizations. Results from my research on executive compensation have been widely cited in the press (including the *Wall Street Journal, New York Times*, *Washington Post*, *Los Angeles Times*, *Chicago Tribune*, *USA Today*, *Economist*, *Fortune*, *Forbes*, *Business Week*, and *Time*) and on national television (including CNN and CBS news). I have offered testimony relating to executive compensation to the U.S. House of Representatives Financial Services Committee and the TARP Congressional Oversight Panel, and given speeches and presentations on compensation and incentives to a variety of academic and practitioner audiences, including the Conference Board, the American Compensation Association, and the Board of Governors of the Federal Reserve.

My university teaching encompasses a wide variety of courses at the undergraduate, MBA, Ph.D., and executive levels. At USC, I have taught undergraduate, MBA, and Ph.D. courses in economics and corporate finance and have developed and taught undergraduate and MBA courses on compensation, incentives, and corporate governance. At Harvard, I taught courses on compensation and incentives in organizations, human resource management, and on the coordination, control, and management of organizations. At Rochester and Chicago, I taught undergraduate courses in microeconomics, MBA and executive courses in microeconomics and pricing policies, MBA and Ph.D. courses in organizational theory, and Ph.D. courses in price theory. I also developed and taught a course in the Economics of Human Resource Management, with a primary focus on compensation for top-level managers.

I have testified as an expert witness in multiple proceedings in federal and state courts. I have consulted with organizations and conducted research on compensation and incentives in professional partnerships and corporations. I spent the 1994–1995 academic year on leave from Harvard as the Visiting Scholar and Consultant at Towers Perrin (now Willis Towers Watson), a major benefits and compensation consulting firm, where my activities included making formal presentations and leading roundtable discussions on executive compensation to clients nationwide, as well as being involved in a variety of consulting engagements.

Kevin J. Murphy
January 25, 2023

Table 1 Target Compensation for Named Defendants, 2014 – 2018

				Allocation of Target Equity		
Year	Salary Rate	Target Bonus (% of Salary)	Target Equity	Performance Units (PUs)	Restricted Stock Units (RSUs)	Non-Qualified Stock Options (NQSOs)
Robert A. Walker (Chairman, President, and CEO)						
2014	$1,300,000	130%	$11,100,000	50%	25%	25%
2015	$1,300,000	130%	$11,100,000	50%	25%	25%
2016	$1,300,000	130%	$11,100,000	50%	25%	25%
2017	$1,300,000	130%	$11,100,000	50%	25%	25%
2018	$1,300,000	130%	$11,100,000	50%	25%	25%
Robert G. Gwin (EVP and CFO)						
2014	$750,000	95%	$4,450,000	50%	25%	25%
2015	$750,000	95%	$4,450,000	50%	25%	25%
2016	$750,000	95%	$4,450,000	50%	25%	25%
2017	$750,000	95%	$4,450,000	50%	25%	25%
2018	$750,000	95%	$4,450,000	50%	25%	25%
Robert P. Daniels (Until 8/2016: EVP, International and Deepwater Exploration)						
2014	$700,000	95%	$4,550,000	50%	25%	25%
2015	$700,000	95%	$4,550,000	50%	25%	25%
2016	$700,000	95%	—	—	—	—
Ernest A. Leyendecker, III (After 8/2016: EVP, International and Deepwater Exploration)						
2014 (SVP)	$400,000	80%	$1,500,000	40%	25%	35%
2015 (SVP)	$420,000	80%	$1,600,000	40%	25%	35%
2016 (SVP)	$420,000	80%	—	—	—	—
2016 (EVP)	$575,000	95%	$2,500,000	50%	25%	25%
2017 (EVP)	$575,000	95%	$2,500,000	50%	25%	25%

Note: Data from annual proxy statements and "tally sheets" (APC-00789245 at 294-313 (2014); APC-00779479 at 530-550 (2015); APC-00784849-867 (2016); APC-01727486 at 531-548 (2018)). Mr. Leyendecker's compensation is inferred from several documents, including APC-00784868 at 881-883; APC-00785266 at 279-280; APC-00786269 at 275; APC-00790225 at 230. Target equity awards differ slightly from ASC 718 grant-date accounting values reported in the proxy statements.

Table 2 Performance Measures and Weights in Anadarko AIP Plan, 2014 – 2018

	2014	2015	2016	2017	2018
Operational					
Reserve Additions (MMBOE)	25%	20%	20%	15%	
Reserve Additions Growth per DAS					20%
Sales Volumes (MMBOE)	25%	10%	20%	20%	
Sales Volume Growth per DAS					20%
Company-Operated Base Sales Volume (MMBOE)		15%			
Financial					
Capital Expenditures ($ mil)	20%	10%	25%	15%	
EBITDAX/BOE ($/BOE)	20%	15%			
Controllable Cash Costs ($/BOE)		15%	25%	15%	20%
Cash Operating Income ($/BOE)				25%	
Cash-Flow ROIC					20%
Relative One-Year TSR		5%			
Safety					
Total Recordable Incident Rate (TRIR)	10%	10%	10%	10%	10%
Level 3 Incidents					10%

Note: Data from "Compensation Discussion and Analysis" section in each annual Proxy Statement.

Table 3 Payouts for Named Executive Officers under AIP Plan, 2014 – 2018

Year	Initial AIP Performance Score	Discretionary AIP Score Adjustment	Individual Performance Adjustment	Final AIP Bonus
2014	151.0%	0%	0%	151.0%
2015	196.5%	-86.5%	0%	110.0%
2016	158.0%	0%	0%	158.0%
2017	92.6%	-7.6%	0%	85.0%
2018	150.0%	0%	0%	150.0%

Note: Data from “Compensation Discussion and Analysis” section in each annual Proxy Statement.

Table 4 Payout Levels under Performance Unit Plan

Relative TSR Ranking	Payout Level (before 11/2014)	Payout Level (11/2014 and later)
1	200%	200%
2	182%	182%
3	164%	164%
4	146%	146%
5	128%	128%
6	110%	100%
7	92%	80%
8	72%	60%
9	54%	40%
10	0%	0%
11	0%	0%
12	0%	0%

Note: Data from "Compensation Discussion and Analysis" section in each annual Proxy Statement.

Table 5 Schedule for TSR Component of 2015 AIP Plan

Relative TSR Ranking	Score for TRS Component	Contribution to 5% of AIP Performance Score
1	275%	13.75%
2	240%	12.00%
3	205%	10.25%
4	170%	8.50%
5	135%	6.75%
6	100%	5.00%
7	83%	4.15%
8	67%	3.35%
9	50%	2.50%
10	33%	1.65%
11	17%	0.85%
12	0%	0.00%

Note: APC-00779578 at 619; Anadarko Petroleum Corporation DEF 14 (Proxy) Statement filed March 18, 2016.

Table 6 Anadarko's Share-Price Performance vs. Peers, 2015

Company	Beginning Average Price	Ending Average Price	Dividends During Period	Total Shareholder Return (TSR)	Rank
Pioneer Natural Resources	$149.63	$136.52	$0.08	-8.7%	1
Occidental Petroleum	$81.02	$70.51	$2.97	-9.3%	2
Chevron	$111.20	$90.24	$4.28	-15.0%	3
EOG Resources	$92.42	$77.44	$0.67	-15.5%	4
ConocoPhillips	$68.65	$50.15	$2.94	-22.7%	5
Apache	$64.29	$46.14	$1.00	-26.7%	6
Hess	$74.82	$53.64	$1.00	-27.0%	7
Noble Energy	$49.91	$34.07	$0.72	-30.3%	8
Anadarko Petroleum	***$82.20***	***$53.54***	***$1.08***	***-33.6%***	***9***
Devon Energy	$60.19	$37.25	$0.96	-36.5%	10
Marathon Oil	$29.10	$15.13	$0.68	-45.7%	11
Chesapeake Energy	$20.04	$4.64	$0.18	-76.0%	12

Note: Anadarko's 2015 Peers from Anadarko Petroleum Corporation DEF 14A (Proxy) Statement filed March 18, 2016, p. 40; price and dividend data from CRSP. Beginning Average Price defined as average closing stock price for the 30 trading days prior to January 1, 2015; Ending Average Price defined as average closing stock price for the 30 trading days prior to January 1, 2016. Total Shareholder Return (TSR) defined as (Ending Price – Beginning Price + Dividends) divided by Beginning Price.

Table 7 RSU Grants under Actual and Steinholt Stock Prices during Class Period

Executive	Actual Stock Price	Steinholt Stock Price	Target RSU Award	RSU Award at Actual Stock Price	RSU Award at Steinholt Stock Price	Difference
October 26, 2015 Grant						
Walker	$69.00	$67.25	$2,775,000	40,217	41,264	+1,047
Gwin	$69.00	$67.25	$1,112,500	16,123	16,543	+420
Daniels	$69.00	$67.25	$1,137,500	16,486	16,914	+428
Leyendecker	$69.00	$67.25	$400,000	5,797	5,948	+151
Total:			*$5,425,000*	*78,623*	*80,669*	*+2,046*
November 10, 2016 Grant						
Walker	$61.87	$59.95	$2,775,000	44,852	46,289	+1,437
Gwin	$61.87	$59.95	$1,112,500	17,981	18,557	+576
Leyendecker	$61.87	$59.95	$625,000	10,102	10,425	+323
Total:			*$4,512,500*	*72,935*	*75,271*	*+2,336*

Note: Data from Table 1; Steinholt Report, Exhibit D; CRSP. Target RSU Awards are calculated based on the Total Equity Award and Target RSU Percentage in Table 1. Actual RSU awards differ slightly from those reported in Anadarko Proxy Statements due to rounding and (in some cases) differing reliance on ASC 718 accounting values.

Table 8 Vesting Value of Additional RSUs Granted under Steinholt Stock Prices

		Walker	Gwin	Daniels	Leyendecker	Total
Additional October 2015 RSU Grant under Steinholt Prices		1,047	420	428	151	2,046
Vesting October 26, 2016	($58.98)	$20,584	$8,257	$8,414	$2,969	$40,224
Vesting October 26, 2017	($47.69)	$16,644	$6,677		$2,400	$25,721
Vesting June 1, 2018	($71.05)				$3,576	$3,576
Vesting October 26, 2018	($58.84)	$20,535	$8,238			$28,773
Total from October 2015 Grant:		$57,763	$23,171	$8,414	$8,945	$98,294
Additional November 2016 RSU Grant under Steinholt Prices		1,437	576		323	2,336
Vesting November 10, 2017	($51.11)	$24,482	$9,813		$5,503	$39,798
Vesting June 1, 2018	($71.05)				$15,299	$15,299
Vesting November 10, 2018	($58.21)	$27,883	$11,176			$39,059
Vesting August 8, 2019	($72.50)	$34,728	$13,920			$48,648
Total from November 2016 Grant:		$87,092	$34,909		$20,802	$142,803
Total from both Grants:		$144,855	$58,081	$8,414	$29,748	$241,098

Note: Data from Table 7; Form 4 filings; Proxy Statements; Steinholt Report, Exhibit D; Merger Proxy; CRSP. Table shows the value of the additional RSUs that would have been granted absent the alleged inflation in stock prices. Values are based on Anadarko closing stock prices on each vesting date, except for October 26, 2016 (during the Class Period) when values are based on the Steinholt Stock Price (the actual closing price of $60.90 minus the alleged inflation of $1.92), and for August 8, 2019 when values are based on the $72.50 per share merger consideration. Amounts exclude the value of dividend equivalents that would have been paid upon vesting.

Table 9 NQSO Grants under Actual and Steinholt Stock Prices during Class Period

Executive	Option Value at Actual Stock Price	Option Value at Steinholt Stock Price	Target NQSO Award	NQSO Award at Actual Stock Price	NQSO Award at Steinholt Stock Price	Difference
October 26, 2015 Grant						
Walker	$17.948	$17.49	$2,775,000	154,615	158,638	4,023
Gwin	$17.944	$17.49	$1,112,500	62,000	63,613	1,613
Daniels	$17.944	$17.49	$1,137,500	63,393	65,043	1,650
Leyendecker	$17.944	$17.49	$560,000	31,209	32,021	812
Total:			*$5,585,000*	*311,217*	*319,316*	8,099
November 10, 2016 Grant						
Walker	$20.306	$19.676	$2,775,000	136,661	141,038	4,377
Gwin	$20.306	$19.675	$1,112,500	54,788	56,543	1,755
Leyendecker	$20.305	$19.675	$625,000	30,780	31,766	986
Total:			*$4,512,500*	222,229	229,346	7,117

Note: Data from Table 1; Proxy Statements; Form 4 filings; Steinholt Report, Exhibit D. Target NQSO Awards are calculated based on the Total Equity Award and Target NQSO Percentage in Table 1. Actual NQSO awards differ slightly from those reported in Anadarko Proxy Statements due to rounding and (in some cases) differing reliance on ASC 718 accounting values.

Table 10 NQSO Exercises under Actual and Steinholt Stock Prices during Class Period

	Walker	Gwin	Daniels	Leyendecker	Total
Actual October 2015 NQSO Grant	154,615	62,000	21,131	20,806	258,552
Stock Price at Exercise	$72.50	$72.50	$72.50	$72.50	$72.50
Exercise Price	$69.00	$69.00	$69.00	$69.00	$69.00
Gain from Exercise	$541,153	$217,000	$73,959	$72,821	$904,932
Actual November 2016 NQSO Grant	136,661	54,788	—	10,260	201,709
Stock Price at Exercise	$72.50	$72.50	—	$72.50	$72.50
Exercise Price	$61.87	$61.87	—	$61.87	$61.87
Gain from Exercise	$1,452,706	$582,396		$109,064	$2,144,167
Steinholt October 2015 NQSO Grant	158,638	63,613	21,681	21,347	265,279
Stock Price at Exercise	$72.50	$72.50	$72.50	$72.50	
Exercise Price	$67.25	$67.25	$67.25	$67.25	
Gain from Exercise	$832,850	$333,968	$113,825	$112,074	$1,392,717
Steinholt November 2016 NQSO Grant	141,038	56,543	—	10,589	208,170
Stock Price at Exercise	$72.50	$72.50	—	$72.50	
Exercise Price	$59.95	$59.95	—	$59.95	
Gain from Exercise	$1,770,027	$709,615		$132,892	$2,612,534
Net gain using Steinholt Stock Prices	*$609,017*	*$244,186*	*$39,867*	*$63,081*	*$956,152*

Note: Data from Table 9; Form 4 filings; Steinholt Report, Exhibit D; Merger Proxy. Mr. Walker's and Mr. Gwin's options were effectively fully vested and exercised upon the Occidental acquisition on August 8, 2019 at the merger consideration of $72.50. I assume that Mr. Daniels and Mr. Leyendecker held the options vested as of their retirements until the merger.

Table 11 Performance Unit Grants Impacted by Alleged Inflation

Grant Date	Performance Period	Reported Rank (Payout as % of Target)	Rank Absent Alleged Inflation	Inflation at Payout	Change in Award Value Absent Alleged Inflation
GROUP 1: PU Grants Before Class Period with Performance Periods ending During Class Period					
5/15/2012	5/15/2012 – 5/14/2015	5 (128%)	5 (128%)	–$1.75	($11,769)
11/5/2012	1/1/2013 – 12/31/2015	8 (72%)	8 (72%)	–$1.75	($39,616)
11/6/2013	1/1/2014 – 12/31/2015	7 (92%)	8 (72%)	–$1.75	($355,598)
11/6/2013	1/1/2014 – 12/31/2016	5 (128%)	5 (128%)	–$1.92	($104,588)
GROUP 2: PU Grants During Class Period with Performance Periods ending After Class Period					
10/26/15	1/1/2016 – 12/31/2018	8 (60%)	7 (80%)	$0	$1,276,531
11/10/16	1/1/2017 – 12/31/2019	(200%)	(200%)	$0	$510,781
				Total:	$1,275,741

Note: Data from Proxy Statements; Steinholt Report, Exhibit D; APC-00780428; APC-00786209; APC-00784868; APC00784847; CRSP; Bloomberg. Table assumes that Mr. Daniels and Mr. Leyendecker both received prorated payouts at the end of the Performance Period, based on actual performance and the number of months worked during the Performance Period. *See* APC-00780428 at 445-447 (2015 grant); APC-00786209 at 219-221 (2016 grant).

Table 12 Change in PU Payouts to Named Defendants Absent the Alleged Inflation

	Walker	Gwin	Daniels	Leyendecker	Total
5/15/2012 (3-Yr)	($11,769)				($11,769)
11/5/2012 (3-Yr)	($21,632)	($7,710)	($7,915)	($2,359)	($39,616)
11/6/2013 (2-Yr)	($183,815)	($73,382)	($75,045)	($23,355)	($355,598)
11/6/2013 (3-Yr)	($54,065)	($21,583)	($22,072)	($6,869)	($104,588)
10/26/15 (3-Yr)	$782,871	$313,924	$106,993	$72,744	$1,276,531
11/10/16 (3-Yr)	$338,879	$135,859	0	$36,043	$510,781
Total:	$850,469	$347,107	$1,961	$76,203	$1,275,741

Note: Data from Proxy Statements; Steinholt Report, Exhibit D; APC-00780428; APC-00786209; APC-00784868; APC00784847; CRSP; Bloomberg. Table assumes that Mr. Daniels and Mr. Leyendecker both received prorated payouts at the end of the Performance Period, based on actual performance and the number of months worked during the Performance Period. *See* APC-00780428 at 445-447 (2015 grant); APC-00786209 at 219-221 (2016 grant).

Table 13 Summary of Changes in Compensation to Named Defendants Absent the Alleged Inflation

	Walker	Gwin	Daniels	Leyendecker	Total
Base Salary	$0	$0	$0	$0	$0
TSR Component of AIP	$0	$0	$0	$0	$0
Restricted Stock Units	$144,855	$58,081	$8,414	$29,748	$241,098
Stock Options	$609,017	$244,186	$39,867	$63,076	$956,147
Performance Units	$850,469	$347,107	$1,961	$76,203	$1,275,741
Total:	$1,604,341	$649,374	$50,242	$169,032	$2,472,990

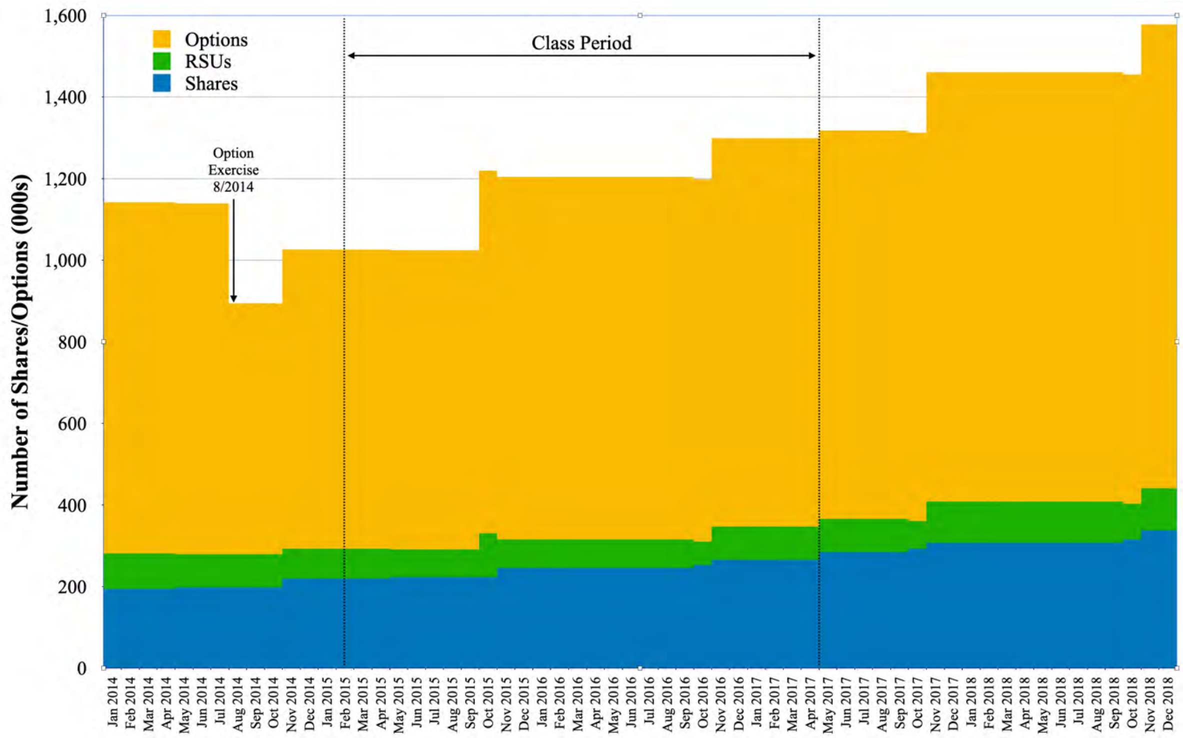
Sources: Tables 8, Table 10, Table 12.

Table 14 Summary of Additional Amounts Named Defendants Would Receive in the Occidental Transaction Absent the Alleged Inflation

	Walker	Gwin	Daniels	Leyendecker	Total
Restricted Stock Units (Table 8)	$34,728	$13,920	$0	$0	$48,648
Stock Options (Table 10)	$609,017	$244,186	$39,867	$63,081	$956,152
Performance Units (Table 12)	$338,879	$135,859	$0	$36,043	$510,781
Total:	$982,624	$393,965	$39,867	$99,124	$1,515,580

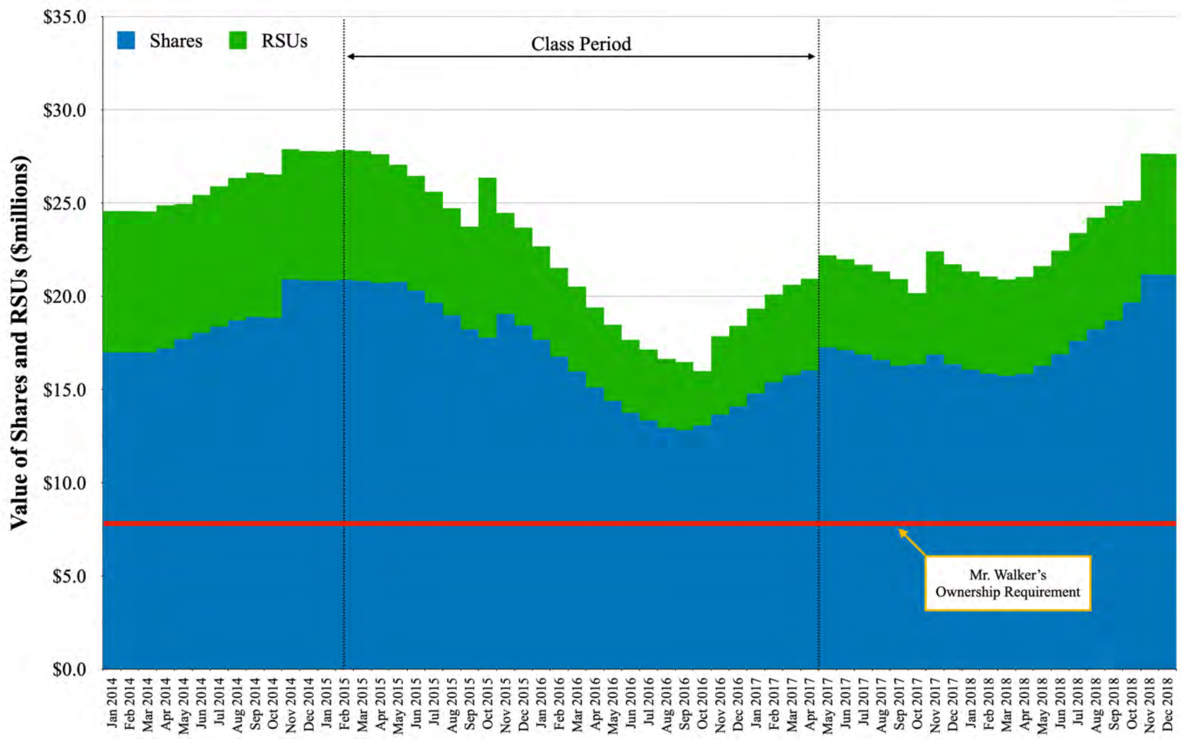
Sources: Tables 8; Table 10; Table 12

Figure 1 Mr. Walker's Holdings of Anadarko's Shares, RSUs, and Options, 2014 – 2018



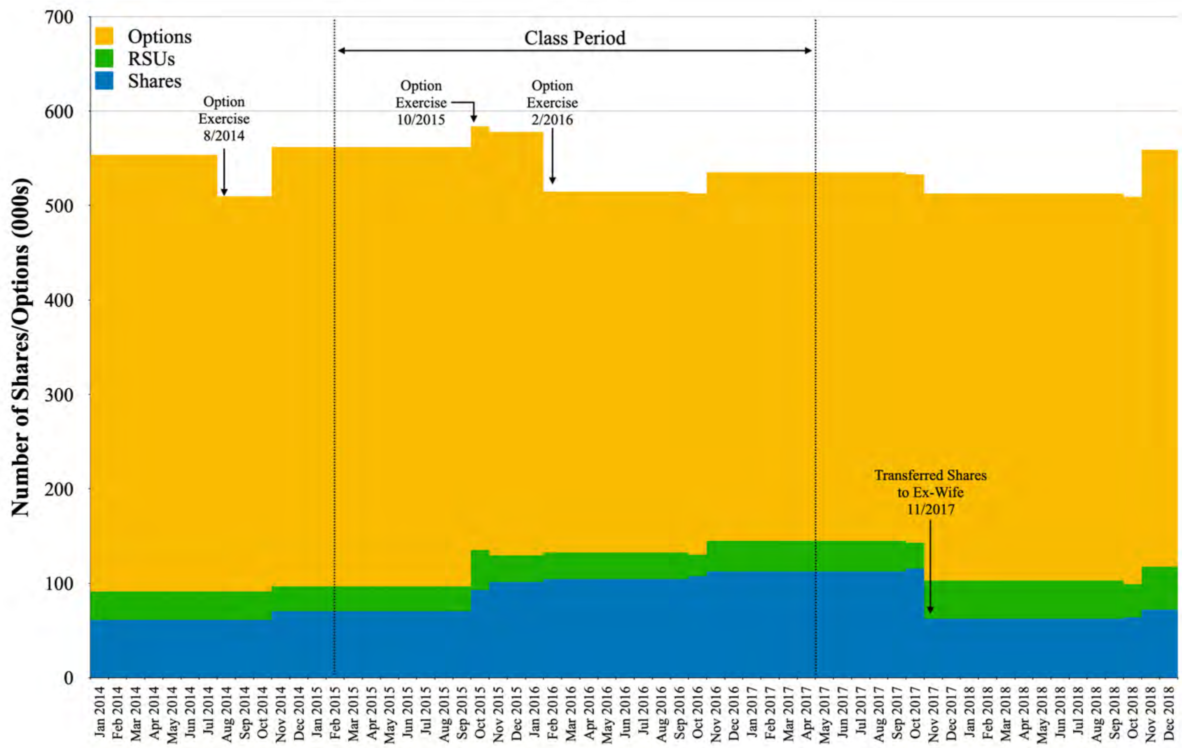
Note: Data are as of the end of each calendar month and are based on data from Anadarko Proxy Statements and Mr. Walker's Form 4s.

Figure 2 Mr. Walker's Share Value vs. Ownership Guidelines, 2014 – 2018



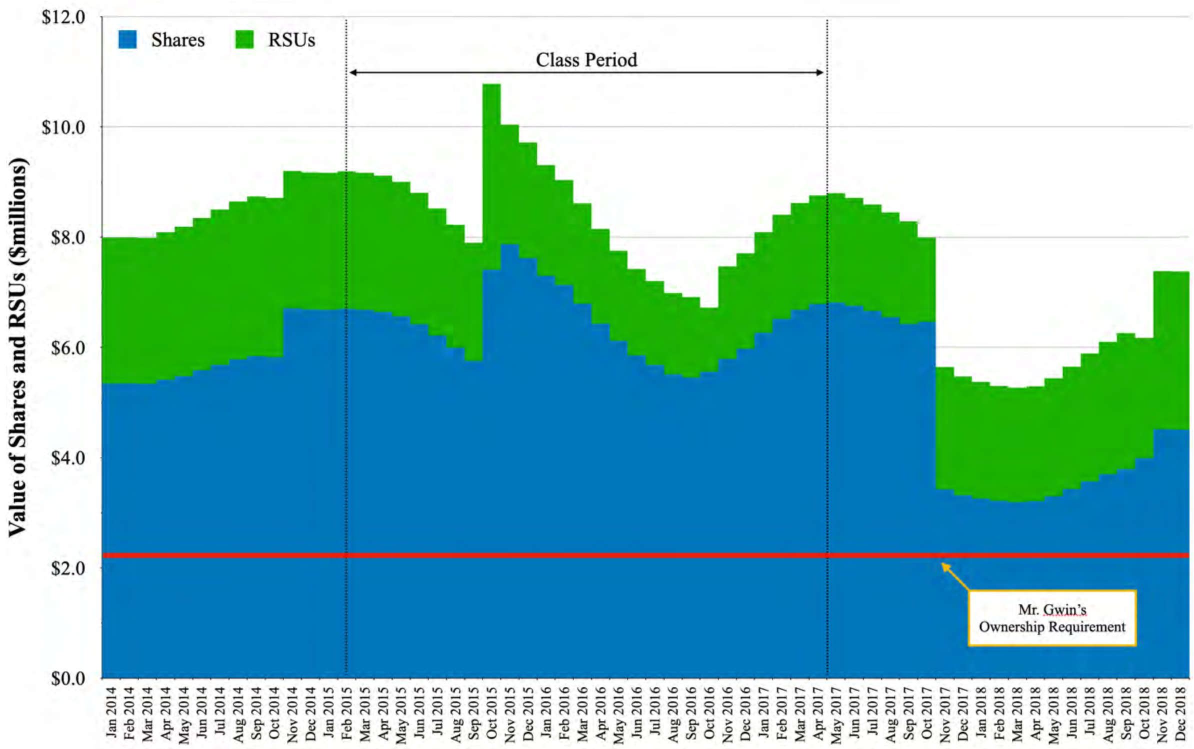
Note: Data are as of the end of each calendar month and are based on data from Anadarko Proxy Statements and Mr. Walker's Form 4s. Value is defined based on shares (or RSUs) held multiplied by the average daily stock price over the preceding year. As CEO, Mr. Walker is required to hold six times his $1.3 million Base Salary in Anadarko shares or RSUs.

Figure 3 Mr. Gwin's Holdings of Anadarko's Shares, RSUs, and Options, 2014 – 2018



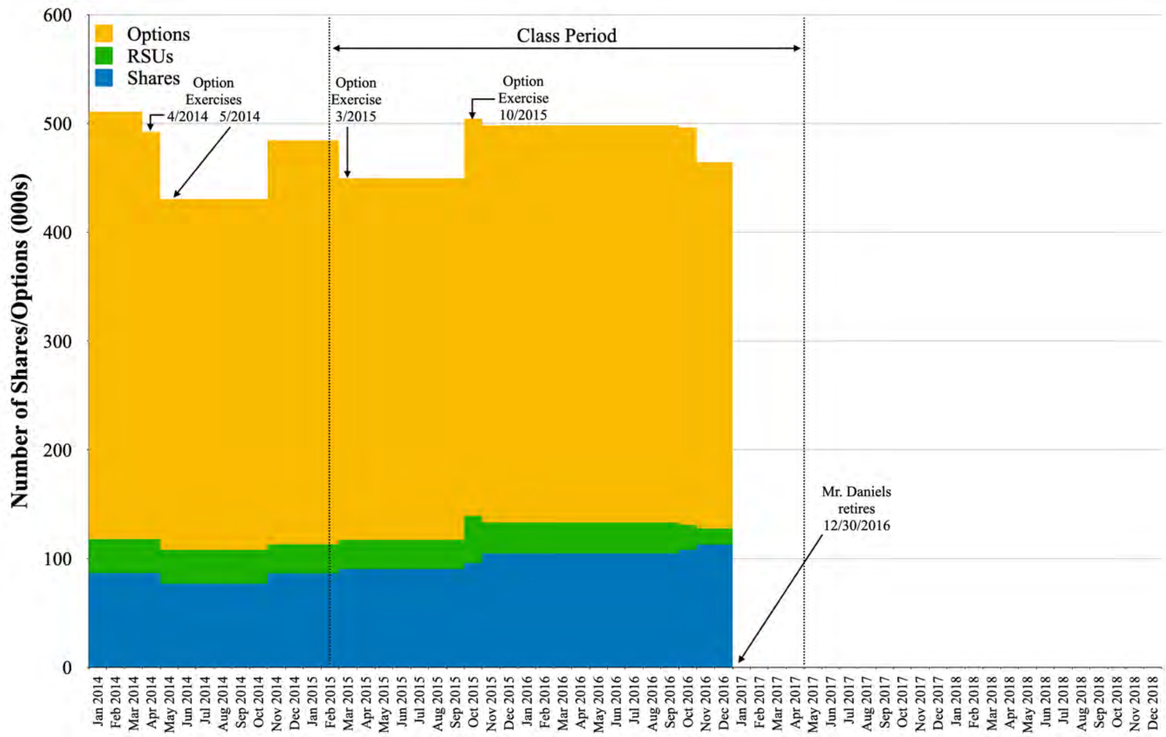
Note: Data are as of the end of each calendar month and are based on data from Anadarko Proxy Statements and Mr. Gwin's Form 4s. Shares include Anadarko shares held in his 401(k) plan.

Figure 4 Mr. Gwin's Share Value vs. Ownership Guidelines, 2014 – 2018



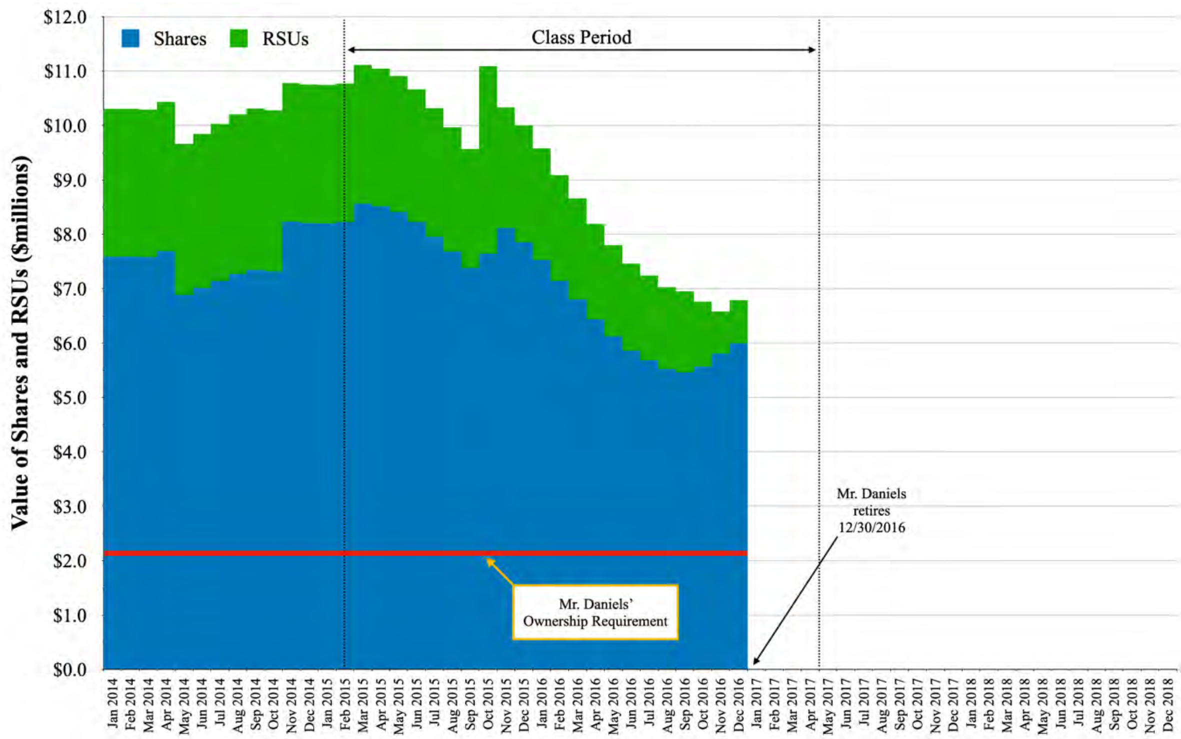
Note: Data are as of the end of each calendar month and are based on data from Anadarko Proxy Statements and Mr. Gwin's Form 4s. Value is defined based on shares (or RSUs) held multiplied by the average daily stock price over the preceding year. As an EVP, Mr. Gwin is required to hold three times his $750,000 Base Salary in Anadarko shares or RSUs.

Figure 5 Mr. Daniels' Holdings of Anadarko's Shares, RSUs, and Options, 2014 – 2018



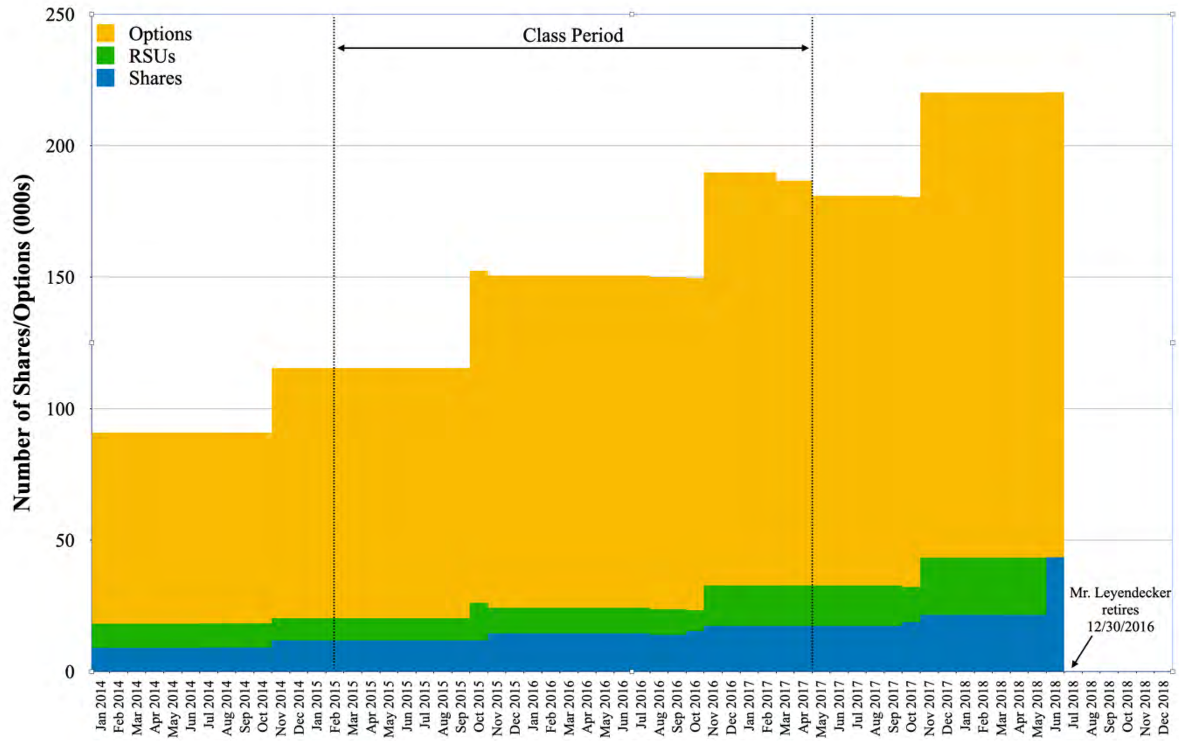
Note: Data are as of the end of each calendar month and are based on data from Anadarko Proxy Statements and Mr. Daniels' Form 4s. Shares include Anadarko shares held in his family Limited Partnership and his 401(k) plan. Mr. Daniels stepped down as EVP in August 2016 and retired from Anadarko in December 2016 (*see* Deposition of Robert P. Daniels dated October 13, 2022 at p. 32).

Figure 6 Mr. Daniels' Share Value vs. Ownership Guidelines, 2014 – 2018



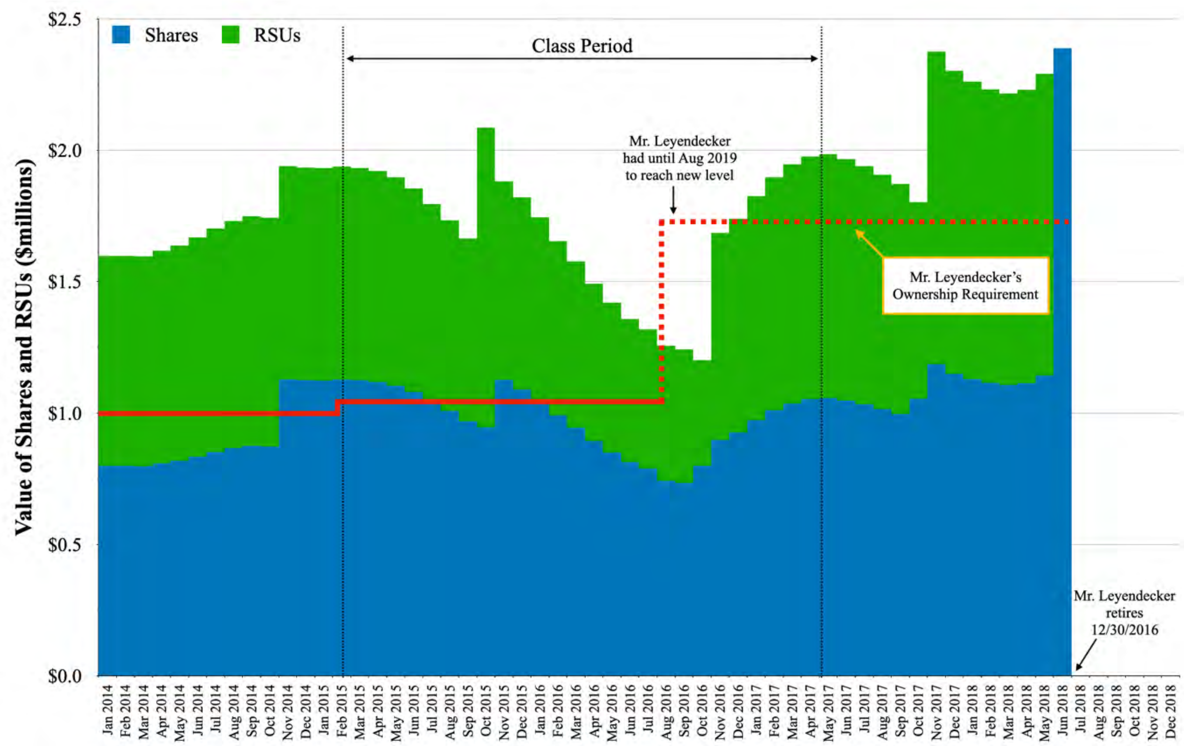
Note: Data are as of the end of each calendar month and are based on data from Anadarko Proxy Statements and Mr. Daniels' Form 4s. Value is defined based on shares (or RSUs) held multiplied by the average daily stock price over the preceding year. As an EVP, Mr. Daniels is required to hold three times his $700,000 Base Salary in Anadarko shares or RSUs. Mr. Daniels stepped down as EVP in August 2016 and retired from Anadarko in December 2016 (*see* Deposition of Robert Daniels, October 13, 2022 at p. 32).

Figure 7 Mr. Leyendecker's Holdings of Anadarko's Shares, RSUs, and Options, 2014 – 2018



Note: Data are as of the end of each calendar month and are based on data from Anadarko Proxy Statements, Mr. Leyendecker's Form 3 and Form 4s, and various internal documents. Data before August 2016 (when Mr. Leyendecker became a Section 16 executive subject to public Form 4 disclosures) are based on various Anadarko and Leyendecker self-reporting "snap-shots" of ownership positions. I have been unable to reconcile a difference of 450 Anadarko shares prior to August 2016 and have incorporated those shares in the chart above to a vesting event in November 2015.

Figure 8 Mr. Leyendecker's Share Value vs. Ownership Guidelines, 2014 – 2018



Note: Data are as of the end of each calendar month and are based on data from Anadarko Proxy Statements, Mr. Leyendecker's Form 3 and Form 4s, and various internal documents. Data before August 2016 (when Mr. Leyendecker became a Section 16 executive subject to public Form 4 disclosures) are based on various Anadarko and Leyendecker self-reporting "snap-shots" of ownership positions. Value is defined based on shares (or RSUs) held multiplied by the average daily stock price over the preceding year. As an SVP through August 2016, Mr. Leyendecker was required to hold 2.5 times his Base Salary (which increased from $400,000 to $420,000 in January 2015) in Anadarko shares or RSUs. Upon his promotion to EVP in August 2016, Mr. Leyendecker had three years to increase his holdings of shares and RSUs to $1,725,000 (*i.e.*, three times the $575.000 Base Salary he earned upon his promotion).

Exhibit A: Curriculum Vitae

KEVIN JAMES MURPHY

Resume
January 2023

Address Marshall School of Business
Finance and Business Economics
University of Southern California
Los Angeles, CA 90089-1422
email: kjmurphy@usc.edu
website: www.marshall.usc.edu/faculty/directory/kjmurphy

Telephone (213) 740-6553

Current Positions

Kenneth L. Trefftzs Chair in Finance, Marshall School of Business, University of Southern California, 2006 -
Department Chair, Finance and Business Economics, Marshall School of Business, University of Southern California, 2020 -
Professor of Finance and Business Economics, Marshall School of Business, University of Southern California, 1995 -
Professor of Business and Law (courtesy), Gould School of Law, University of Southern California, 2001 -

Previous Positions

Vice Dean for Faculty and Academic Affairs, Marshall School of Business, University of Southern California, 2004 - 2007
E. Morgan Stanley Chair in Business Administration, Marshall School of Business, University of Southern California, 2002 - 2005
Department Chair, Finance and Business Economics, Marshall School of Business, University of Southern California, 2003 - 2004
Visiting Scholar and Consultant, Towers Perrin, Boston, MA, 1994 - 1995
Associate Professor, Graduate School of Business Administration, Harvard University, 1991 - 1995
Associate Professor, William E. Simon Graduate School of Business Administration, University of Rochester, 1989 - 1991.
Assistant Professor, William E. Simon Graduate School of Business Administration, University of Rochester, 1983 - 1989.
Marvin Bower Fellow, Graduate School of Business Administration, Harvard University, 1987-1988.

Education

University of Chicago, Ph.D. (Economics), 1984.
University of Chicago, M.A. (Economics), 1981.
University of California, Los Angeles, B.A. (Economics) (Summa Cum Laude), 1979.

Thesis

"Ability, Performance, and Compensation: A Theoretical and Empirical Investigation of Managerial Labor Contracts"

Teaching Experience

University of Southern California, Marshall School of Business, 1995-. Undergraduate, MBA, and Ph.D. courses in financial policies, economics, corporate control, compensation, incentives, and corporate governance.
Harvard University, Graduate School of Business Administration, 1991-1995. Graduate courses in compensation and incentives, human resource management, and coordination, control, and the management of organizations.
University of Rochester, William E. Simon Graduate School of Business Administration, 1984-1991. Graduate courses in compensation and human resource management, organization theory, economics, advanced price theory, and pricing policies.
University of Chicago, Department of Economics, 1981-83. Undergraduate courses in price theory.

Fellowships, Scholarships, Academic Honors

Drexel University award for Outstanding Contribution to Research in Corporate Governance, 2013
Marvin Bower Fellowship, Harvard University, 1987-88.
AT&T Faculty Fellowship, University of Rochester, 1986-87.
Social Science Research Council Dissertation Fellowship, 1983-84.
PEW Teaching Fellowship, University of Chicago, 1981-83.
Milton Friedman Fund Fellowship, University of Chicago, 1979-83.
National Science Foundation Fellowship, 1979-82.
Regents Scholarship, UCLA, 1977-79.
Department Scholar (Economics), UCLA, 1978-79.
Phi Beta Kappa, 1979.

Other Activities

Associate Editor, *Journal of Financial Economics*, 1992-2021.
Associate Editor, *Journal of Accounting and Economics*, 1988-2006.
Associate Editor, *Journal of Corporate Finance*, 1993-2010.
Associate Editor, *Economic Bulletin*, 2001-2003.
Expert, U.S. Department of Treasury, Office of the Special Master for Executive Compensation, 2009.
Board Member, Scleroderma Foundation (Southern California Chapter), 2008-2011.
Chairman, Academic Research Committee, American Compensation Association, 1997 - 1999.
Research Advisory Board, American Compensation Association, 1997 - 1999.
Chairman, Research Advisory Panel, American Compensation Association, 1995 - 1997.
Program Committee, American Economic Association Meetings, 2000-2001.
Program Committee, *Journal of Financial Economics* Corporate Governance Conference, 2000.
Program Committee, Western Finance Association Conference, 1996, 1997.
Program Committee, American Finance Association Meetings, 1998, 2003.
University of Southern California, Academic Senate, 2011-2015 (Executive Committee 2012-2015); Professional Conflict of Interest Committee, 2013-; Provost's Interdisciplinary Professor Committee, 2007-2013; Deans of Faculty Council, 2004-2007; Academic Leadership Committee, 2004-2006; Probationary Deadlines Committee, 2004-2006; Provost Advisory Committee, 2003-2004.
University of Southern California, Marshall School of Business, Faculty Council 2011-; Faculty Consultative Committee, 2001-2003. Strategic Planning Steering Group (co-chairman), 1999-2000; Research Committee, 1997-1998; Budget Advisory Committee, 1998-1999; STAR Committee, 1998-1999; Space Utilization Task Force, 1998-; MBA Quality of Life Committee, 1997.
University of Southern California, Marshall School of Business, Finance and Business Economics, Faculty recruiting co-chairman, 1995-1999, 2011-2012; APR Committee 2001-2003; 2007-2012.
William E. Simon Graduate School of Business Administration, University of Rochester, Area Coordinator for Applied Economics and Organizations and Markets, 1985-1991; Ph.D. Committee, 1984-1987, 1988-1991; Committee on Computing and Data Bases, 1990–1991.
Referee for Professional Journals: *Academy of Management Journal; Accounting Review; Administrative Science Quarterly; American Economic Review; American Journal of Sociology; Canadian Journal of Economics; Econometrica; Economic Inquiry; The Economic Journal; Economic Policy Review (NY Fed); Financial Management; Industrial and Labor Relations Review; Industrial Relations; Journal of Accounting and Economics; Journal of Accounting, Auditing, and Finance; Journal of Accounting and Public Policy; Journal of Business; Journal of Economics and Business; Journal of Finance; Journal of Financial and Quantitative Analysis; Journal of Financial Economics; Journal of Institutional and Theoretical Economics; Journal of Labor Economics; Journal of Law & Economics; Journal of Law, Economics, and Organization; Journal of Management Studies; Journal of Monetary Economics; Journal of Political Economy; Journal of Risk and Insurance; Management Science; Managerial and Decision Economics; National Tax Journal; Pacific-Basin Finance Journal; Quarterly Journal of Economics; Quarterly Review of Economics and Business; Rand Journal of Economics; Review of Economics and Statistics; Review of Financial Studies; Review of Quantitative Finance and Economics; Strategic Management Journal;* and the National Science Foundation.
Advisory Board, *Business Month*, 1990-1991.
Member, American Economic Association, 1981-present.
Member, Society of Labor Economists, 1995-2007.
Member, American Finance Association, 1995-present.
Member, WorldAtWork (formerly American Compensation Association), 1995-2002.
Member, Task Force on Executive Compensation, American Compensation Association, 1984-1985.
Commissioner, National Association of Corporate Directors Blue Ribbon Commission on Executive Compensation, 1992, 2003.

Publications: Professional Articles

Baker, George, Robert Gibbons, and Kevin J. Murphy, "From Incentives to Control to Adaptation: Exploring Interactions Between Formal and Relational Governance." *Journal of Institutional and Theoretical Economics* (Forthcoming 2023).

Dial, Jay and Kevin J. Murphy, "Downsizing and Value Creation at General Dynamics: A PE-like Solution for Industries that Must Shrink," *Journal of Applied Corporate Finance*, Vol. 33(3) (Summer 2021).

Barron, Daniel, Robert Gibbons, Ricard Gil and Kevin J. Murphy, "Relational Adaptation Under Reel Authority." *Management Science* 66(5) (May 2020) 1868-1889.

Murphy, Kevin J. and Tatiana Sandino, "Compensation Consultants and the Level, Composition and Complexity of CEO Pay" *The Accounting Review* 95(1) (January 2020) 311-341.

Murphy, Kevin J. and Michael C. Jensen, "The Politics of Pay: The Unintended Consequences of Regulating Executive Compensation." *Journal of Law, Finance, and Accounting* 3(2) (2018) 189-242.

Murphy, Kevin J., "Regulating Banking Bonuses in the European Union: A Case Study in Unintended Consequences," *European Financial Management* 19(4) (2013) 631-657.

Fernandes, Nuno, Miguel A. Ferreira, Pedro Matos, and Kevin J. Murphy, "Are US CEOs Paid More? New International Evidence." *Review of Financial Studies* 26(2) (2013), 323-367.

Murphy, Kevin J., "Executive Compensation: Where we are, and how we got there," in George Constantinides, Milton Harris, and René Stulz (eds.), *Handbook of the Economics of Finance*. Elsevier Science North Holland (2013) Chapter 4: 211-356.

Conyon, Martin J., Nuno Fernandes, Miguel A. Ferreira, Pedro Matos, and Kevin J. Murphy, "The Executive Compensation Controversy: A Transatlantic Analysis" in Tito Boeri, Claudio Lucifora, and Kevin J. Murphy (eds.), *Executive Packages: Productivity, Profits, and Pay,* Fondazione Rodolfo Debenedetti Series, Oxford University Press (2013) Part I: 8-115.

Murphy, Kevin J., "Pay, Politics, and the Financial Crisis" in Alan Blinder, Andrew Lo and Robert Solow (eds.), *Economic Lessons from the Financial Crisis*. Russell Sage Foundation (2012).

Murphy, Kevin J., "The Politics of Pay: A Legislative History of Executive Compensation," in Jennifer Hill and Randall Thomas (eds.), *Research Handbook on Executive Pay,* Edward Elgar Publishers (2012).

Murphy, Kevin J. and Tatiana Sandino, "Executive Pay and "Independent" Compensation Consultants," *Journal of Accounting & Economics* 49(3) (April 2010): pp. 247-262.

Baker, George, Robert Gibbons, and Kevin J. Murphy, "Strategic Alliances: Bridges Between 'Islands of Conscious Power'," *Journal of the Japanese and International Economies,* 22(2) (June 2008) 146-163.

Lowry, Michelle and Kevin J. Murphy, "Executive Stock Options and IPO Underpricing," *Journal of Financial Economics* 85 (2007) 39-65.

Murphy, Kevin J. and Ján Zábojník, "CEO pay and appointments: A market-based explanation for recent trends," *American Economic Review Papers and Proceedings,* (May 2004).

Publications: Professional Articles (continued)

Hall, Brian J. and Kevin J. Murphy, "The Trouble with Stock Options," *Journal of Economic Perspectives*, Vol. 17(3), (Summer 2003).

Murphy, Kevin J., "Stock-Based Pay in New Economy firms," *Journal of Accounting and Economics*, Vol 34 (2003): 129-147.

Murphy, Kevin J., "Explaining Executive Compensation: Managerial Power versus the Perceived Cost of Stock Options," *University of Chicago Law Review*, Vol. 69(3) (Summer 2002): 847-869.

Hall, Brian J. and Kevin J. Murphy, "Stock Options for Undiversified Executives," *Journal of Accounting and Economics*, Vol 33(1) (February 2002): 3-42.

Baker, George, Robert Gibbons, and Kevin J. Murphy, "Relational Contracts and the Theory of the Firm," *Quarterly Journal of Economics,* Vol. 117 (February 2002): 39-84.

Reprinted in
C. Ménard (ed.), *The International Library of the New Institutional Economics*, (Forthcoming 2004): Edward Elgar Publishing, Ltd.

Conyon, Martin J. and Kevin J. Murphy, "Stock-Based Executive Compensation," in J. McCahery, P. Moerland, T. Raaijmakers, and L. Renneboog, ed., *Corporate Governance Regimes: Convergence and Diversity*, Oxford University Press (2002), Chapter 26: 625-646.

Baker, George, Robert Gibbons, and Kevin J. Murphy, "Bringing the Market Inside the Firm?" *American Economic Review Papers and Proceedings,* Vol 92(2) (May 2001): 212-18.

Murphy, Kevin J., "Performance Standards in Incentive Contracts," *Journal of Accounting and Economics*, Vol. 30 (3) (December 2000): 245-78.

Conyon, Martin J. and Kevin J. Murphy, "The Prince and the Pauper? CEO Pay in the US and UK," *Economic Journal* Vol 110 (November 2000): F640-71.

Reprinted in
van Frederikslust, R. A. I, J. S. Ang, and S. Sudarsanam (eds), *Corporate Governance and Corporate Finance: a European Perspective*. Routledge (2007)

Hall, Brian J. and Kevin J. Murphy, "Optimal Exercise Prices for Executive Stock Options," *American Economic Review Papers and Proceedings,* Vol 90(2) (May 2000): 209-214.

Baker, George, Robert Gibbons, and Kevin J. Murphy, "Informal Authority in Organizations," *Journal of Law, Economics, and Organizations* Vol. 15(1) (April 1999): 56-73.

Murphy, Kevin J., "Executive Compensation," in Orley Ashenfelter and David Card (eds.), *Handbook of Labor Economics*, Vol. 3b, Elsevier Science North Holland (1999), Chapter 38: 2485-2563.

Murphy, Kevin J., "Executive Compensation and the Modern Industrial Revolution," *International Journal of Industrial Organization*, Vol. 15(4) (July 1997): 417-25.

Murphy, Kevin J., "Reporting Choice and the 1992 Proxy Disclosure Rules," *Journal of Accounting, Auditing, and Finance*, Vol. 11(3) (Summer 1996): 497-515.

Dial, Jay and Kevin J. Murphy, "Incentives, Downsizing, and Value Creation at General Dynamics," *Journal of Financial Economics*, Vol. 37(3) (March 1995): 261-314.

Murphy, Kevin J., "Politics, Economics, and Executive Compensation," *University of Cincinnati Law Review*, Volume 63, No. 2 (Winter 1995): 713-748.

Publications: Professional Articles (continued)

Baker, George, Robert Gibbons, and Kevin J. Murphy, "Subjective Performance Measures in Optimal Incentive Contracts," *Quarterly Journal of Economics*, Vol. 109(4) (November 1994): 1125-56.

Murphy, Kevin J. and Jerold L. Zimmerman, "Financial Performance Surrounding CEO Turnover," *Journal of Accounting and Economics*, Vol. 16 (1993): 273-315.
Reprinted in
K. Hallock and K. Murphy (eds.), *The Economics of Executive Compensation*, Vol. 2 (1999): 377-419 Elgar Reference Collection, International Library of Critical Writings in Economics, vol. 103.

Gibbons, Robert and Kevin J. Murphy, "Does Executive Compensation Affect Investment?" *Journal of Applied Corporate Finance*, Vol. 5(2) (Summer 1992).

Gibbons, Robert and Kevin J. Murphy, "Optimal Incentive Contracts in the Presence of Career Concerns: Theory and Evidence," *Journal of Political Economy*, Vol. 100(3) (June 1992): 468-505.

Reprinted in
K. Hallock and K. Murphy (eds.), *The Economics of Executive Compensation*, Vol. 1 (1999): 515-52 Elgar Reference Collection, International Library of Critical Writings in Economics, vol. 103.

Murphy, Kevin J., "Performance Measurement and Appraisal: Motivating Managers to Identify and Reward Performance," *Performance Measurement, Evaluation, and Incentives*, edited by William J. Bruns, Jr. (Harvard Business School Press, Boston, 1992).

Reprinted in
Employment Relations Today, Vol. 20, No. 1 (Spring, 1993).

Jensen, Michael C. and Kevin J. Murphy, "CEO Incentives: It's Not *How Much* You Pay, But *How*", *Harvard Business Review*, (May/June, 1990).

Reprinted in:
M. Jensen, *Foundations of Organizational Strategy* (1998): 270-98, *Harvard University Press*;
Journal of Applied Corporate Finance, Vol. 3(3) (Fall 1990).

Jensen, Michael C. and Kevin J. Murphy, "Performance Pay and Top-Management Incentives" *Journal of Political Economy*, Vol. 98(2) (April 1990): 225-64.

Reprinted in:
M. Jensen, *Foundations of Organizational Strategy* (1998): 229-69, *Harvard University Press*.

K. Keasey, S. Thompson, and M. Wright (eds.), *Corporate Governance*, Vol. 3, Governance mechanisms Part 2 (1999): 236-75 Elgar Reference Collection, International Library of Critical Writings in Economics, vol. 106;

K. Hallock and K. Murphy (eds.), *The Economics of Executive Compensation* , Vol. 1 (1999): 260-299, Elgar Reference Collection, International Library of Critical Writings in Economics, vol. 103.

Gibbons, Robert and Kevin J. Murphy, "Relative Performance Evaluation for Chief Executive Officers", *Industrial and Labor Relations Review*, Vol. 43, No. 3 (February 1990): 30S-51S.

Reprinted in:
R. G. Ehrenberg (ed.), *Do Compensation Policies Matter?* 1990, ILR Press-Cornell, Ithaca NY;
K. Hallock and K. Murphy (eds.), *The Economics of Executive Compensation* , Vol. 1 (1999): 392-413, Elgar Reference Collection, International Library of Critical Writings in Economics, vol. 103.

Publications: Professional Articles (continued)

Baker, George, Michael C. Jensen, and Kevin J. Murphy "Compensation and Incentives: Practice vs. Theory," *Journal of Finance*, Vol. 43(3) (July 1988): 593-616.

Reprinted in:

M. Jensen, *Foundations of Organizational Strategy* (1998), *Harvard University Press*.

K. Keasey, S. Thompson, and M. Wright (eds.), *Corporate Governance*, Vol. 3, Governance mechanisms Part 2 (1999): 121-44 Elgar Reference Collection, International Library of Critical Writings in Economics, vol. 106.

Murphy, Kevin J., "Incentives, Learning, and Compensation: A Theoretical and Empirical Investigation of Managerial Labor Contracts," *Rand Journal of Economics*, Vol. 17(1) (Spring 1986): 59-76.

Reprinted in:

K. Hallock and K. Murphy (eds.), *The Economics of Executive Compensation* , Vol. 1 (1999): 417-34, Elgar Reference Collection, International Library of Critical Writings in Economics, vol. 103.

Murphy, Kevin J., "Top Executives Are Worth Every Nickel They Get," *Harvard Business Review*, Vol. 64(2) (March/April 1986).

Reprinted in:

L. Newton and M. Ford (eds.), *Taking Sides*, 2nd edition, edited by Lisa H. Newton and Maureen M. Ford (Dushkin Publishing Group, Inc., Guilford CT, 1992).

Murphy, Kevin J., "Corporate Performance and Managerial Remuneration: An Empirical Analysis," *Journal of Accounting and Economics*, Vol. 7 (April 1985): 11-42.

Reprinted in:

O. Ashenfelter and K. F. Hallock (eds.) *Labor Economics*, Vol. 2 (Edward Elgar Publishing: 1995);

K. Keasey, S. Thompson, and M. Wright (eds.), *Corporate Governance*, Vol. 3, Governance mechanisms Part 2 (1999): 204-35 Elgar Reference Collection, International Library of Critical Writings in Economics, vol. 106;

K. Hallock and K. Murphy (eds.), *The Economics of Executive Compensation* , Vol. 1 (1999): 204-35, Elgar Reference Collection, International Library of Critical Writings in Economics.

Books

Boeri, Tito, Claudio Lucifora, and Kevin J. Murphy (eds.), *Executive Remuneration and Employee Performance-Related Pay: A Transatlantic Perspective,* Fondazione Rodolfo Debenedetti Series, Oxford University Press (2013).

Hallock, Kevin F. and Kevin J. Murphy (co-editors), *The Economics of Executive Compensation*, Edward Elgar Publishing, 1999.

Comments, Cases, and Other Articles

Kevin J. Murphy, "Executive Pay Restrictions for TARP Recipients: An Assessment," Testimony to the Congressional Oversight Panel, October 21, 2010.

Kevin J. Murphy, Congressional Testimony on Compensation Structure and Systemic Risk, June 11, 2009.

Hall, Brian J. and Kevin J. Murphy, "Expensing will improve compensation decisions," *Boston Globe*, October 6, 2002.

Hall, Brian J. and Kevin J. Murphy, "Option Value Does Not Equal Option Cost," *WorldatWork Journal*, 10(2), 2001.

Hallock, Kevin F. and Kevin J. Murphy, "The Economics of Executive Compensation: Introduction," in *The Economics of Executive Compensation* (K. Murphy and K. Hallock, eds.), Edward Elgar Publishing, 1999.

Murphy, Kevin J., "Executive Stock Options: An Economist's Perspective," in *Stock Options*, American Compensation Association, 1998.

Murphy, Kevin J., "Disney Offers a Model for Executive Compensation," *Los Angeles Business Journal*, June 23, 1997.

Murphy, Kevin J., "CEO Pay and Downsizing: The Social Consequences," in *CEO Pay: A Comprehensive Look*, American Compensation Association, 1997.

Jensen, Michael C. and Kevin J. Murphy, "Compensation at Lexerd Systems," Harvard Business Case 494-066 (April 1994).

Murphy, Kevin J., "Executive Compensation in Corporate America 1993," United Shareholders Association, (Nov. 1993).

Murphy, Kevin J., "Executive Compensation in Corporate America 1992," United Shareholders Association, (Dec. 1992).

Murphy, Kevin J. and Jay Dial, "Compensation and Strategy and General Dynamics (A), (B)," Harvard Business Cases 9-494-048 and 9-494-049 (October 1993).

Murphy, Kevin J., "Merck & Co., Inc. (A), (B), (C)," Harvard Business Cases 9-491-005, 9-491-006, and 9-491-007 (November, 1991).

Jensen, Michael C. and Kevin J. Murphy, "A New Survey of Executive Compensation: Full Survey and Technical Appendix to 'CEO Incentives — It's Not *How* Much You Pay but *How*," Simon School of Business, University of Rochester (June 1990).

Murphy, Kevin J., "The Control and Performance of State-Owned Enterprises: Comment," in *Privatization and State-Owned Enterprises*, edited by Paul MacAvoy, W. T. Stanbury, George Yarrow, and Richard J. Zeckhauser (Kluwer Academic Publishers, Boston, 1989): 59-68.

Murphy, Kevin J., "Is Executive Compensation Related to Company Performance?" *Rochester Management Review* (1985).

Jensen, Michael C. and Kevin J. Murphy, "Beware the Self-Serving Critics" *New York Times* (May 20, 1984).

Unpublished Papers

Murphy, Kevin J. and Marshall D. Vance, "Debunking Diversification: Evidence from Employee Stock Option Exercises" (March 2020)

Lee, Joonil, Sunghan Lee, Kevin J. Murphy, and Peter S. H. Oh, "Compensating with Style: The Role of Compensation-Committee Experience on CEO Pay." (October 2021)

Lee, Joonil, Kevin J. Murphy, Peter S. H. Oh, and Marshall D. Vance, "CEO Inside Debt and Corporate Investment." (December 2020)

Baker, George, Robert Gibbons, and Kevin J. Murphy, "Relational Adaptation." (December 2011)

Murphy, Kevin J. and Ján Zábojník, "Managerial Capital and the Market for CEOs" University of Southern California (August 2007).

Murphy, Kevin J. and Paul Oyer, "Discretion in Executive Incentive Contracts," University of Southern California (January 2004).

Murphy, Kevin J. and Karen E. Van Nuys, "Governance, Behavior, and Performance of State and Corporate Pension Funds," Harvard University (September 1994).

Murphy, Kevin J., "Executive Compensation in Regulated Firms," William E. Simon Graduate School of Business Administration, University of Rochester (April 1987).

Consulting and Expert Witness Activities

Law Firms:

Bartlit Beck Herman Palenchar & Scott; Foley & Lardner; Gibson, Dunn & Crutcher; Girard and Green; Goodwin Procter LLP; Greenberg, Glusker; Kirkland & Ellis; Irell & Manella; Laski & Gordon; Latham & Watkins; Milberg Weiss; Morgan Lewis & Bockius; Munger, Tolles & Olson; Nixon and Peabody; O'Melveny & Myers LLP; Orrick, Herrington & Sutcliffe; Pillsbury Winthrop; Seyfarth Shaw LLP; Sheppard Mullin Richter & Hampton LLP; Simpson Thacher & Bartlett; Skadden, Arps, Slate, Meagher & Flom; Steptoe & Johnson; Swaab Attorneys (Sydney, Australia); Tanenbaum Keale LLP; Teadle (C. Tucker); Wheeler Trigg O'Donnell LLP; Williams & Connolly; Willkie Farr & Gallagher; Wilson Sonsini Goodrich & Rosati; Winston & Strawn.

Economic Litigation Firms:

Analysis Group; Chicago Partners; CRA International; Compass Lexecon; Cornerstone Research; Econalytics; LECG, Navigant.

Consulting Clients:

Arthur D. Little, Inc.; AT&T; Atlantic Richfield Corporation; Axos Financial, Inc.; Bristol-Myers Company; British Petroleum; California Franchise Tax Board; California Franchise Tax Board; CalPers; Casa Cuervo, S.A. de C.V.; Cemex; Chatham Technologies Inc.; Gannett Co.; Genzyme; Grupo Reforma; GTE; Hunt Oil Company; Internal Revenue Service; Kay and Associates, Inc.; Life Technologies; Management Compensation Group; Merck & Co; the State of Michigan; Moody's Inc.; Nellie Mae; Pulsar; Remington Oil and Gas Corporation; Residence Mutual Insurance Company; Selbert Perkins Design; TCL Beatrice; Towers Perrin; University of Pennsylvania; VectorMAX; Western Mutual Insurance.

Papers and Speeches Presented (1991–Present)

Speeches, Panel Discussions, and Corporate Presentations on Executive Compensation

- Panel on "Executive Pay during Covid," University of Miami, Miami FL, November 13, 2020.
- Panel on "The Role of Corporate Governance amidst the Covid-19 Pandemic," Drexel University, Philadelphia PA, April 17, 2020.
- Principles of Executive Pay Roundtable, Aspen Institute, New York, NY, November 6, 2019
- Overview and Research Session, "Executive Compensation: The Politics of Pay," Financial Management Association Annual Meeting, Boston, MA, October 12, 2017.
- Keynote Speech, "Explaining CEO Pay," 10th International Conference on Asia-Pacific Financial Markets, Seoul, South Korea, December 5, 2015.
- "Earnings Management and Executive Pay: Are Options to Blame?" Korean Capital Market Research Center, Seoul, South Korea, December 4, 2015
- "Explaining CEO Pay," Federal Reserve Bank of New York, September 15, 2015.
- "Paying for Performance: Metrics, Maladies and Mistakes," CFO Roundtable, March 5, 2015.
- Corporate Governance Summit, University of Southern California, Los Angeles, CA, November 14, 2014.
- "Measuring CEO Performance: Metrics, Maladies and Mistakes," West Coast Chairs Roundtable, November 3, 2014.
- Panelist, Equilar Executive Compensation Summit, Coronado, CA, June 17, 2014.
- Keynote Speech, "Explaining CEO Pay," Ackerman Conference on Corporate Governance, Bar Ilan University, Ramat Gan, Israel, December 15, 2013.
- Roundtable on Incentive Pay for Bankers, Board of Governors, U.S. Federal Reserve, Washington DC, November 19, 2013.
- Corporate Governance Summit, University of Southern California, Los Angeles, CA, November 15, 2013.
- Keynote Speech, "Explaining CEO Pay," CEO, Boards and other High Potentials, Institute for Financial Research, Stockholm School of Economics, Stockholm, Sweden, October 16, 2013.
- Keynote Speech, "Explaining CEO Pay," Twenty Years after Cadbury, Ten Years after Sarbanes-Oxley: Challenges of Corporate Governance, University of Bath, Bath, UK, June 24, 2013.
- Keynote Speech, "Explaining CEO Pay," Mini Conference on Executive Compensation, Hong Kong Polytechnic University, June 6, 2013.
- Keynote Speech, "Explaining CEO Pay," Claremont College, May 6, 2013.
- Keynote Speech, "Explaining CEO Pay," 6th Annual Conference on Corporate Governance, Drexel University, April 5, 2013.
- Corporate Governance Summit, University of Southern California, Los Angeles, CA, November 9, 2012.
- Executive Compensation Workshop, Swedish Remuneration Academy, Stockholm, Sweden, September 25-26, 2012.
- Corporate Governance Summit, University of Southern California, Los Angeles, CA, October 28, 2011.
- Equilar Executive Compensation Summit, Carlsbad, CA, June 14, 2011.
- NOVA Finance Center Conference on Executive Compensation, Lisbon, Portugal, March 15, 2011.
- X Madrid Finance Workshop on Executive Compensation, Madrid, Spain, March 11, 2011.
- Corporate Governance Summit, University of Southern California, Los Angeles, CA, October 26, 2010
- Testimony to the Congressional Oversight Panel, Washington, DC, October 21, 2010
- Risk Conference, Federal Reserve Bank of Chicago, Chicago, Il, April 7, 2010
- Corporate Governance Summit, University of Southern California, Los Angeles, CA, November 13, 2009
- Testimony to the U.S. House of Representatives, Committee on Financial Services, Hearing on "Compensation Structure and Systemic Risk," Washington, DC, June 11, 2009
- Conference on Financial Innovation, Owen Graduate School of Management, Vanderbilt University, October 17, 2008
- Executive Compensation Workshop: Rethinking Pay for Performance, U.C. Berkeley Law School, September 26, 2008
- Weil Gotshal & Manges Roundtable, Yale Law School, May 4, 2007

Speeches, Panel Discussions, and Corporate Presentations on Executive Compensation

– Corporate Governance Summit, University of Southern California, Los Angeles, CA, March 23, 2007
– Corporate Governance Conference, University of Melbourne School of Law, Melbourne, Victoria, Australia, March 15, 2007
– Chief Financial Officer Forum, University of Washington, Seattle, WA, February 7, 2007
– Conference Board Executive Pay Conference, New York City, NY, September 27, 2006
– Fireside Talk, Amos Tuck School of Business, Dartmouth University, Hanover, NH, May 18, 2006
– 125 Celebration, University of Southern California, Los Angeles, CA, October 7, 2005.
– Corporate Governance Conference, London School of Economics, London, UK, November 4, 2004.
– Challenges to Executive Compensation Conference, University of Zurich, Zurich, Switzerland, November 2, 2004.
– Academic Advisory Board, Wells Capital Management, San Francisco, CA, May 25, 2004.
– Executive Session, European Science Days, Steyr, Austria, July 16 , 2003.
– The Economist Human Resource Roundtable, New York, NY, June 5, 2003.
– Corporate Governance Conference, Wilmington, DE, April 9, 2003.
– Annual Meeting, Center for Effective Organizations, Marina del Rey, CA, April 24, 2003.
– Executive Compensation Workshop, Harvard Business School, Boston, MA, October 10, 2002.
– Special Board of Directors Meeting, Genzyme Inc., Cambridge, MA, October 2, 2002.
– Option Workshop, California Public Employees’ Retirement System, Sacramento CA, June 17, 2002.
– American Economic Association Annual Meetings, New Orleans, LA, January 7, 2001.
– Princeton/Cornell Conference on Labor Policy, Ithaca, NY, October 7, 2000.
– University of Illinois, Northbrook, IL, October 6, 2000.
– United States Department of Justice, Washington, D.C., September 27, 2000
– Singapore Institute of Directors, September 13, 2000.
– Corporate Governance and Value Creation Conference, National University of Singapore, September 12, 2000.
– Young Presidents Organization, Los Angeles, CA, November 12, 1998.
– Keynote Speech, Executive Compensation Forum, American Compensation Association, Chicago IL, September 24, 1998.
– Towers Perrin Training Session, London, UK, June 22-24, 1998.
– Institute of Management Accountants, Los Angeles, CA, March 27, 1998.
– Executive Compensation Seminar, The Conference Board, San Diego, CA, March 11, 1998.
– Executive Briefing Seminars and Roundtables, Irvine, CA (Oct. 29, 1997), Woodland Hills (Nov. 4, 1997), Los Angeles, CA (Nov. 5, 1997)
– Conference on Executive Compensation and Shareholder Value, New York University Stern School of Business, October 24, 1997.
– Board of Governors of the Federal Reserve, Washington, DC. October 23, 1997.
– Committee on Corporate Governance, TIAA-CREFF, Stanford, CA. June 27, 1997.
– Executive Compensation Seminar, The Conference Board, Chicago, IL, June 4, 1997.
– Society of Human Resource Managers, Marina del Rey, CA, April 30, 1997.
– Financial Management Association Meetings, New Orleans, LA, October 10, 1996.
– International Business Machines, Armonk, NY, September 13, 1996.
– Bristol-Myers-Squibb Corporation, New York City, NY, September 11, 1996.
– American Enterprise Institute, Washington DC, July 22, 1996.
– USC Center for Effective Organizations sponsors meeting, Newport Beach, CA, May 8, 1996.
– Corporate Governance Seminar, University of Toronto Law School, Toronto, CA, Dec. 8, 1995
– Yale Finance Institute, Woodstock, VT, October 23, 1995
– Oil Industry Roundtable, Colorado Springs, CO, September 21, 1995
– Corporate Governance Seminar, London School of Economics, London, MA, June 15, 1995
— Executive Briefing Seminars and Roundtables, Dallas TX (Sept. 14, 1994), Chicago IL (Nov. 17, 1994), Philadelphia PA (Jan. 3, 1995) Washington DC (Feb. 1, 1995), Richmond VA (Feb. 2, 1995), Irvine CA (March 6, 1995), Boston MA (March 9, 1995), Minneapolis MN (Dec. 15, 1994), Atlanta GA (April 26, 1995)
– Merck Corporation, White House Station, NJ, June 19, 1995

Speeches, Panel Discussions, and Corporate Presentations on Executive Compensation

– Chubb Corporation, NJ, March 30, 1995
– Bristol-Myers-Squibb Corporation, New York City, NY, February 10, 1995
– Prudential Corporation, Newark, NJ, January 24, 1995
– Mead Corporation, Dayton, OH, September 14, 1994
– Procter & Gamble, Cincinnati, OH, September 14, 1994– International Business Machines, Armonk, NY, September 8, 1994
– AT&T, Basking Ridge, NJ, August 11, 1994
– Philip Morris, New York, NY, August 9, 1994
– General Motors, New York, NY, August 9, 1994
– Conference on Management Compensation, Strategy, and Firm Performance, Humboldt-University, Berlin, Germany, June 13, 1994.
– Human Resource Executive Association, Cincinnati, OH, March 16, 1994.
– Corporate Law Symposium, University of Cincinnati Law School, Cincinnati, March 18, 1994.
– Executive Compensation Training Session, Towers Perrin, Leesburg, VA, October 7, 1993.
– SEC and Financial Reporting Institute Conference, Pasadena, CA, May 27, 1993.
– NASDAQ Regional Conference, Atlanta, GA, May 25, 1993.
– NASDAQ Regional Conference, Dallas, TX, May 24, 1993.
– Management Conference, University of Chicago Graduate School of Business, Chicago, Illinois, April 28, 1993.
– National Investor Relations Institute—Chicago Chapter, Chicago, Illinois, April 7, 1993.
– National Association of Corporate Directors, Waltham, MA, March 23, 1993.
– Conference on Managerial Pay and Corporate Performance, March 20, 1993.
– Shadow SEC, Washington, D.C., November 9, 1992.
– American Enterprise Institute, Washington, D.C., October 21, 1992.
– MCG/NACD Seminar on Executive Compensation, San Francisco, CA, May 5, 1992.
– Security and Exchange Commission Conference on Corporate Governance, Washington, D.C., March 19, 1992.
– MCG/NACD Seminar on the Compensation Committee in the 1990s, New York, NY, December 12, 1991.
– United Shareholders Association, Washington, D.C., November 15, 1991.
– Olin Business School, Washington University, St. Louis, MO, September 26, 1991.
– Human Resources Management Association of Chicago, Chicago, IL, March 14, 1991.

"Compensating with Style: The Role of Compensation-Committee Experience on CEO Pay"
– McGill Accounting Research Conference, McGill University, Montreal, Canada, May 28, 2021.
– Brown-Bag Seminar, Marshall School of Business, University of Southern California, October 12, 2021.

"Debunking Diversification: Evidence from Employee Stock Option Exercises"
– Ackerman Corporate Governance Conference, Bar Ilan University, Tel Aviv, Israel December 16, 2019.
– Brown-Bag Seminar, Marshall School of Business, University of Southern California, October 16, 2019.
– BI Corporate Governance Conference, BI Norwegian Business School, Oslo, Norway, May 24, 2019.

"The Politics of Pay"
– Securities and Exchange Commission, Washington DC, October 24, 2018.
– Journal of Law, Finance, and Accounting Conference, Hong Kong Polytechnic University, Hong Kong, June 9, 2017.
– Vanderbilt Law & Business Conference, Nashville, TN. October 14, 2011.

"Regulating Banking Bonuses in the European Union: A Case Study in Unintended Consequences"
– European Financial Management Association Annual Meeting, Reading UK, June 27, 2013.

"CEO Inside Debt and Corporate Investment"
– Finance Seminar, Gies College of Business, University of Illinois, Champaign, IL, April 18, 2019.
– 2016 Corporate Governance Conference, LeBow College of Business, Drexel University, Philadelphia, PA, April 15, 2016.
– Finance Seminar, Freeman School of Business, Tulane University, New Orleans LA, April 1, 2016.

"Relational Adaptation under Reel Authority"
– Strategy Seminar, Rotman School of Business, University of Toronto, Toronto, ON, November 9, 2017.
– Microeconomics Seminar, Economics Department, Queens University, Kingston, ON, October 20, 2016.
– Finance Seminar, Jesse Jones School of Business, Rice University, October 23, 2015.
– Finance, Organizations, and Markets Conference, University of Chicago Booth School of Business, October 15,

2015.
– Brown-Bag Seminar, Marshall School of Business, University of Southern California, October 22, 2014.

"Compensation Consultants and the Level, Composition, and Complexity of CEO Pay"
– Securities and Exchange Commission, Washington DC, October 23, 2018.
– Accounting Workshop, McGill University Desautels School of Business, September 14, 2018.
– Labor Workshop, School of Industrial and Labor Relations, Cornell University, April 23, 2018.
– Finance Workshop, R. H. Smith School of Business, University of Maryland, October 10, 2014.
– Finance and Accounting Workshop, Edwin L. Cox School of Business, Southern Methodist University, August 29, 2014.

"Executive Compensation: Where We Are, and How We Got There"
– Accounting for Accounting in Economics Conference, Laboratory for Aggregate Economics and Finance, Santa Barbara, CA, November 8, 2013.
– Finance Seminar, Copenhagen Business School, Copenhagen, Denmark. June 1, 2012.
– Finance Seminar, BI Norwegian Business School, Oslo, Norway. May 30, 2012.
– Helsinki Finance Seminar, Aalto University, Helsinki, Finland. May 28, 2012.
– Workshop on Executive Compensation and Corporate Governance, Erasmus University, Rotterdam, Netherlands. May 25, 2012.
– Finance Seminar, Louisiana State University E. J. Ourso College of Business, Baton Rouge, LA. April 20, 2012.

"Pay, Politics, and the Financial Crisis"
– KAIST CEO Forum, Seoul, South Korea, December 4, 2015
– Twenty Years after Cadbury, Ten Years after Sarbanes-Oxley: Challenges of Corporate Governance, University of Bath, Bath, UK, June 25, 2013.
– Mini Conference on Executive Compensation, Hong Kong Polytechnic University, June 7, 2013.
– Finance Seminar, University of Colorado Leeds School of Business, April 6, 2012.
– Finance Seminar, University of Michigan Ross School of Business, December 16, 2011.
– Conference on Economic Lessons from the Financial Crisis, Russell Sage Foundation, New York City, September 9, 2011.

"Are US CEOs *Still* Paid More?"
– Jindal School of Management, University of Texas - Dallas, Richardson, TX, November 4, 2011.
– Kelley School of Business, University of Indiana, Bloomington, IN, April 29, 2011.
– NOVA Finance Center Conference on Executive Compensation, Lisbon, Portugal, March 15, 2011.
– X Madrid Finance Workshop on Executive Compensation, Madrid, Spain, March 11, 2011.
– American Finance Association Annual Meetings, Denver, CO, January 8, 2011.

"Executive Pay and 'Independent' Compensation Consultants"
– Finance Seminar, Board of Governors, Federal Reserve, Washington D.C., June 9, 2009.
– Oliver E. Williamson Seminar on Institutional Analysis, Haas Business School, University of California, Berkeley, May 7, 2009.
– Interdisciplinary Seminar, Case Western University, April 1, 2009

"The Executive Compensation Controversy: A Transatlantic Analysis"
– Conference on "Productivity, Profits and Pay," Cagliari, Sardinia Italy May 29, 2010.
– Faculty Seminar, Said Business School, Oxford University, May 25, 2010.

"Executive Stock Options and IPO Underpricing"
– Financial Seminar, University of Washington, Seattle, WA, February 7, 2007
– Law and Economics Seminar, Yale Law School, November 16, 2006.
– Research Seminar, Federal Reserve Bank of New York, New York, NY, June 15, 2006.
– Finance Seminar, Amos Tuck School of Business, Dartmouth University, Hanover, NH, May 18, 2006.
– Finance Seminar, Harvard Business School, Boston MA, April 6, 2005.

"The Trouble with Stock Options"
– Finance Seminar, University of Oregon, Eugene, OR, May 16, 2003.
– Conference on Work and Productivity, European Science Days, Steyr, Austria, July 18 , 2003.

"Managerial Capital and the Market for CEOs" (with Ján Zábojník)
– Labor Economcs/Industrial Relations Seminar, Princeton University, Princeton, NJ, November 17, 2004.
– Corporate Governance and Financial Reporting Conference, Napa, CA, April 3, 2004.

– American Economic Association Annual Meetings, Washington DC, January 5, 2003.

"Discretion in Executive Incentive Contracts"
– Information, Markets, and Organizations Conference, Harvard Business School, June 21, 2004
– Finance Seminar, Arizona State University, Tempe, AZ, October 26, 2002.
– Finance Seminar, DePaul University, Chicago, IL, September 17, 2002.
– National Bureau of Economic Research, Corporate Finance Seminars, August 1, 2002
– Personnel Economics Conference, Stanford Institute of Theoretical Economics, Stanford University, Palo Alto, CA, June 21, 2002.
– CLEO Workshop, University of Southern California School of Law, Los Angeles, CA, July 2, 2001.
– American Economic Association Annual Meetings, New Orleans, LA, January 6, 2001.

"Stock Options for Undiversified Executives"
– Law and Business Conference, Vanderbilt University Law School, March 22, 2002.
– Accounting Workshop, Stanford Graduate School of Business, Palo Alto, CA, October 17, 2001.
– Economics of Organizations Workshop, Harvard Business School and MIT Sloan School of Management, Cambridge, MA October 11, 2001
– Corporate Governance Conference, Journal of Financial Economics and Tuck Business School, Dartmouth College, Hanover, NH, July 7, 2000
– European Summer Symposium on Economic Theory, Gerzensee, Switzerland, July 11, 2000

"Optimal Exercise Prices for Executive Stock Options"
– American Economic Association meetings, Boston, MA, January 5, 2000.

"The Prince and the Pauper: CEO Pay in the US and UK"

– Research Seminar, IZA Institute for Labor Studies, Bonn, Germany, July 20, 1999.
– Conference on Convergence and Diversity in Corporate Governance Regimes and Capital Markets, Tilburg University, Eindhoven, Netherlands, November 5, 1999.

"Performance Standards in Incentive Contracts"
– Theory of Organizations Workshop, Graduate School of Business, University of Chicago, Chicago, IL May 15, 2000.
– Labor and Population Seminar, Department of Economics, University of California, Los Angeles, March 7, 2000.
– Business Law and Economics Seminar, Olin School of Business, Washington University, St. Louis, September 30, 1999.
– Accounting and Finance Joint Seminar, Graduate School of Business Administration, University of Michigan, Ann Arbor, September 24, 1999.
– Accounting Seminar, William E. Simon Graduate School of Business Administration, University of Rochester, Rochester, NY, May 27, 1999.
– Finance Seminar, Lunquist School of Management, University of Oregon, Eugene, Oregon, April 2, 1999.Corporate Finance Seminar, Yale School of Management, Yale University, March 26, 1999.
– Finance Seminar, Graduate School of Management, University of California, Irvine, December 2, 1998.
– Joint Microeconomics and Finance Seminar, Marshall School of Business, University of Southern California, October 23, 1998.
– Finance Seminar, Stern School of Business, New York University, New York, October 21, 1998.
– Joint Management and Strategy and Accounting Seminar, Kellogg Graduate School of Management, Northwestern University, Evanston, IL, October 14, 1998.
– Economics Seminar, Claremont Graduate School, Claremont, CA, September 30, 1998.
– Finance Seminar, University of Warwick, Warwick, UK, July 18, 1998.
– UCI-UCLA-USC Finance Conference, Ojai, CA, May 14, 1998.
– Society of Labor Economists Meetings, San Francisco, CA, May 1, 1998.
– Economics of Organizations Workshop, Harvard Business School and MIT Sloan School of Business, February 19, 1998
– Finance Workshop, Kenan-Flagler Business School, Univ. of North Carolina, October 21, 1997.
– Academy of Management Symposium, Vancouver, B.C., August 7, 1995

"Relational Contracts and the Theory of the Firm"

– Finance Workshop, Tuck Business School, Dartmouth College, Hanover, NH, December 3, 1996.
– Finance and Economics Workshop, Jesse Jones School of Business, Rice University, Houston, TX, November 15,

1996.
– Economics, Finance, and Strategy Workshop, Marshall School of Business, University of Southern California, November 1, 1996.
– Industrial Organization Workshop, Economics Department, University of California at Los Angeles, October 18, 1996.
– Finance and Economics Workshop, Graduate School of Business, Columbia University, New York, NY, September 14, 1996.
– American Law and Economics Association Conference, Chicago, IL, May 11, 1996.
– Atlanta Financial Forum, Goizueta School of Business, Emory University, Atlanta, GA, May 3, 1996.
– Finance Workshop, School of Business, Texas A&M, College Station, TX, April 26, 1996.

"Executive Compensation"
– Workshop on Corporate Governance; Contracts and Managerial Incentives, Humbodlt University, Berlin, Germany, July 2, 1998.
– Handbook of Labor Economics Conference, Princeton University, Princeton, NJ, September 6, 1997.

"Incentives, Downsizing, and Value Creation at General Dynamics"
– Finance Seminar, Marshall School of Business, University of Southern California, January 13, 1995.
– Harvard Business School, Boston, MA, October 1, 1995.
– American Economic Association Meetings, Boston, MA, January 4, 1994.

"Subjective Performance Measures in Optimal Incentive Contracts"
– Applied Economics Workshop, Laval University, Quebec City, Canada, April 8, 1993.
– Applied Microeconomics Workshop, Graduate School of Business, Columbia University, New York, NY, February 3, 1993.
– Finance Workshop, Graduate School of Business, University of Indiana, Bloomington, IN, December 11, 1992.
– Conference on Compensation and Incentives, Montreal, Canada, June 13, 1992.

"Financial Performance Surrounding CEO Turnover"
– Applied Economics Seminar, University of Delaware, April 29, 1992.
– Finance Seminar, Graduate School of Business Administration, University of Texas, Austin, TX, May 8, 1992.
– Organizational Behavior Work-in-Progress Seminar, Graduate School of Business Administration, Harvard University, Boston, MA, December 2, 1991.
– Conference on Managerial Incentives and Corporate Performance, University of Rochester, Rochester, NY, November 1-2, 1991.

"Governance, Behavior, and Performance of State and Corporate Pension Funds"
– Pension Conference, Miami University, Oxford, Ohio, June 3, 1994
– Finance Workshop, Graduate School of Business, University of Texas, Austin, TX, May 6, 1994.
– Faculty Research Seminar, Owen Graduate School of Management, Nashville, TN, April 26, 1994.
– Research Seminar, Faculty of Management, University of Toronto, Toronto, Ontario, April 4, 1994.
– Faculty Research Seminar, University of Cincinnati Law School, Cincinnati, OH, March 17, 1994.
– Finance Seminar, University of Cincinnati Business School, Cincinnati, OH, March 16, 1994.
– Finance Workshop, Ohio State University, Columbus, OH, March 11, 1994.
– Economics and Legal Organizations Workshop, Economics Department and Graduate School of Business, University of Chicago, Chicago, IL, March 3, 1994.
– Baker West Seminar, Graduate School of Business Administration, Harvard University, Boston, MA, February 28, 1994.
– Applied Economics Workshop, Economics Department, Cornell University, Ithaca, New York, February 23, 1994.
– Applied Economics Workshop, Economics Department, Clemson University, Clemson, South Carolina, February 4, 1994.
– Organizations and Markets Workshop, William E. Simon Graduate School of Business Administration, University of Rochester, Rochester, NY, December 16, 1993.
– Finance Workshop, Smeal College of Business Administration, Pennsylvania State University, State College, PA, December 10, 1993.
– Organizational Behavior and Theory of the Firm Workshop, Graduate School of Business Administration, Harvard University, Boston, MA, November 15, 1993.
– Finance Workshop, Boston College, Brookline, MA, November 12, 1993.
– Economics Workshop, Miami University, Oxford, Ohio, October 22, 1993
– Applied Economics Workshop, Marshall School of Business, University of Southern California, October 16, 1993.

Exhibit B: Testifying Experience in the Last Five Years

I have testified as an expert at trial or by deposition in the following cases within the preceding five years:

1. Richard J. Tornetta v. Elon Musk, et al.
   Testimony: November 18, 2022
   Deposition: September 19, 2021
   C.A. No. 2018-0408-JRS
   Delaware Chancery Court

2. In re Mindbody, Inc. Stockholder Litigation.
   Testimony: March 7, 2022
   Deposition: January 20, 2022
   C.A. No. 2019-0442-KSJM
   Delaware Chancery Court

3. Larry A. Lawson v. Spirit Aerosystems
   Testimony: June 17, 2021
   Deposition: August 7, 2020
   Case No. 6:18-CV-01100-EFM-ADM
   United States District Court for the District of Kansas

4. In re the Marriage of Clarke v. Clarke
   Deposition: August 6, 2020
   Case No. RID1601464
   Superior Court of the State of California, County of Riverside

5. Laborers' Local #231 Pension Fund vs. Rory J. Cowan, et al.
   Deposition: July 31, 2019
   Case No. 1:17-cv-00478-CFC
   United States District Court, District of Delaware

6. Gadeco, LLC, et al. vs Jack J. Grynberg, et al.
   Testimony: June 12, 2019
   Deposition: September 11, 2017
   Case No. 2016CV030959
   District Court, Arapahoe County, Colorado

7. In re the Marriage of Bunting vs. Bunting
   Testimony: June 12, 2018
   Case No. 15D000711
   Superior Court of the State of California, County of Orange

8. Priority Posting & Publishing, Inc. vs The California Franchise Tax Board
   Testimony: June 6, 2018
   Case No. CGC-15-544791
   Superior Court of the State of California, County of San Francisco

Exhibit C: Materials Considered in Producing this Report

Legal Pleadings, Expert Reports and Court Documents

Amended Complaint for Violations of Federal Securities Laws, August 17, 2020
Expert Report of Bjorn I. Steinholt, CFA dated November 9, 2022
Expert Report of D. Paul Regan, CPA/CFF dated November 9, 2022
In Re Silicon Graphics Inc. Securities Litigation, 183 F.3d 970, 987 (9th Cir. 1999)
Southland Sec. Corp. v. INSpire Ins. Sols., Inc., 365 F.3d 353 (5th Cir. 2004)
Abrams v. Baker Hughes, Inc., 292 F.3d 424 (5th Cir. 2002)
Motion for Class Certification and Memorandum of Law in Support, ECF No. 86, dated October 1, 2021

Depositions and Exhibits

Deposition of Charles F. Oudin, III dated June 30, 2022 (with Exhibits)
Deposition of David Blakeley, dated August 19, 2022 (with Exhibits)
Deposition of Ernest A. Leyendecker, III, dated September 22, 2022 (with Exhibits)
Deposition of Lea Frye, dated October 7, 2022 (with Exhibits)
Deposition of Robert Daniels, dated October 13, 2022 (with Exhibits)
Deposition of Robert Alvin Walker, dated October 20, 2022 (with Exhibits)
Deposition of Robert G. Gwin, dated October 26, 2022 (with Exhibits)
Deposition of Bjorn I. Steinholt, CFA dated December 21, 2022 (with Exhibits)
Deposition of Paul Regan, dated January 20, 2023 (with Exhibits)
Deposition of Sean Boyle, November 9, 2021 (with Exhibits)
Deposition of Chris Camden, July 14, 2022 (with Exhibits)
Deposition of James Kleckner, October 14, 2022 (with Exhibits)
Deposition of Patrick McGrievy, August 24, 2022 (with Exhibits)
Deposition of Robert Strickling, July 21, 2022 (with Exhibits)
Deposition of John Schmidt, June 1, 2022 (with Exhibits)
Deposition of Darrell Hollek, September 1, 2022 (with Exhibits)
Deposition of Shandell Szabo, October 28, 2022 (with Exhibits)
Deposition of Mark Zajac, November 2, 2022 (with Exhibits)

Board and Committee Minutes

Anadarko Petroleum Corporation Meeting of the Board of Directors (07/26/2013 Draft), May 13 & 14, 2013 (APC-00584025-039; APC-00584041-055; APC-00584057-071)
Anadarko Petroleum Corporation Meeting of the Board of Directors, May 13 & 14, 2013 (APC-00772672-686)
Anadarko Petroleum Corporation Approval of Minutes for May 13 & 14, 2013, May 20, 2013, May 28, 2013, and June 14, 2013 (07/31/2013 drafts) (APC-00772520-548)
Anadarko Petroleum Corporation Risk Council Meeting Agenda and Meeting Materials, January 28, 2014 (APC-00596519-565)

Anadarko Petroleum Corporation Scheduled Meeting of the Compensation and Benefits Committee of the Board of Directors, February 10, 2014 (APC-00775465-471)

Anadarko Petroleum Corporation Shenandoah Integrated Partner Meeting, April 30, 2014 (APC-00690371-442)

Anadarko Petroleum Corporation Special Meeting of the Compensation and Benefits Committee Agenda and Meeting Materials, October 28, 2014 (APC-00789245-316)

Anadarko Petroleum Corporation Special Meeting of the Compensation and Benefits Committee Agenda and Meeting Materials, October 28, 2014 and November 6, 2014 (APC-00776406-424)

Anadarko Petroleum Corporation Risk Council Meeting Discussion Materials, January 21, 2015 (APC-00611028-077)

Anadarko Petroleum Corporation Regular Meeting of the Compensation and Benefits Committee of the Board of Directors, July 27, 2015 (APC-00778129-244; APC-00778263-385)

Anadarko Petroleum Corporation Special Meeting of the Compensation and Benefits Committee Agenda and Meeting Materials, October 21, 2015 (APC-00779479-550)

Anadarko Petroleum Corporation Special Meeting of the Compensation and Benefits Committee Agenda and Meeting Materials, October 26, 2015 (APC-00779578-647)

Anadarko Petroleum Corporation Special Meeting of the Compensation and Benefits Committee Meeting Minutes, October 21, 2015 and October 26, 2015 (APC-00780428-448)

Anadarko Petroleum Corporation Meeting of the Board of Directors (12/22/2015 Draft), November 2 & 3, 2015 (APC-00667005-014)

Anadarko Petroleum Corporation Scheduled Meeting of the Compensation and Benefits Committee of the Board of Directors, February 8, 2016 (APC-00783560-572)

Anadarko Petroleum Corporation Regular Meeting of the Compensation and Benefits Committee of the Board of Directors, May 9, 2016 (APC-01452536)

Anadarko Petroleum Corporation Regular Meeting of the Compensation and Benefits Committee of the Board of Directors, July 26, 2016 (APC-00783757-870)

Anadarko Petroleum Corporation Special Meeting of the Compensation and Benefits Committee Meeting Minutes, July 26, 2016, August 19, 2016 and October 24, 2016 (APC-00785266-283)

Anadarko Petroleum Corporation Special Meeting of the Compensation and Benefits Committee of the Board of Directors, October 24, 2016 (APC-00784922-999)

Anadarko Petroleum Corporation Scheduled Meeting of the Compensation and Benefits Committee of the Board of Directors, November 10, 2016 (APC-00786209-223; APC-00786269-284)

Anadarko Petroleum Corporation Scheduled Meeting of the Compensation and Benefits Committee of the Board of Directors, February 8, 2017 and March 13, 2017 (APC-00787943-952)

Anadarko Petroleum Corporation Special Meeting of the Compensation and Benefits Committee of the Board of Directors, March 13, 2017 (APC-00787342)

Anadarko Petroleum Corporation Scheduled Meeting of the Compensation and Benefits Committee of the Board of Directors, November 14, 2017 (APC-00790250-267)

Anadarko Petroleum Corporation Special Telephonic Meeting of the Compensation and Benefits Committee Agenda and Meeting Materials, October 25, 2018 (APC-01727486-548)
Anadarko Petroleum Corporation Special Telephonic Meeting of the Compensation and Benefits Committee Agenda (APC-00771149)
Anadarko Petroleum Corporation Scheduled Meeting of the Compensation and Benefits Committee of the Board of Directors, November 14, 2018 (APC-00790771-786)
Anadarko Petroleum Corporation Special Meeting of the Compensation and Benefits Committee of the Board of Directors, November 15, 2018 (APC-00790787-788)
Anadarko Petroleum Corporation Scheduled Meeting of the Compensation and Benefits Committee of the Board of Directors, February 12, 2019, March 14, 2019, April 10, 2019 and April 11, 2019 (APC-00790975-986)
Anadarko Petroleum Corporation Special Meeting of the Compensation and Benefits Committee of the Board of Directors, April 10, 2019 (APC-00790956-967)

Other Bates-stamped Documents

ANACOP00000001
ANACOP00000400
ANACOP00000485
ANACOP00000536
ANACOP00001235
APC-00001146
APC-00003844
APC-00011019
APC-00015880
APC-00016935
APC-00017295
APC-00021089
APC-00022603
APC-00028226
APC-00100713
APC-00129328
APC-00129328
APC-00148012
APC-00170332
APC-00175650
APC-00346806
APC-00358392
APC-00564433
APC-00570424
APC-00570526
APC-00570642

APC-00571115
APC-00583654
APC-00584025
APC-00584041
APC-00584057
APC-00584245
APC-00590807
APC-00592109
APC-00593995
APC-00596519
APC-00599188
APC-00611028
APC-00618360
APC-00633494
APC-00634041
APC-00634058
APC-00634183
APC-00634206
APC-00634268
APC-00639341
APC-00639483
APC-00639546
APC-00650760
APC-00664216
APC-00664217
APC-00667005
APC-00673040
APC-00673190
APC-00679074
APC-00690371
APC-00713302
APC-00718272
APC-00755169
APC-00755204
APC-00771148
APC-00771149
APC-00771156
APC-00771173
APC-00771208
APC-00771357
APC-00771473
APC-00772520
APC-00772672
APC-00773377

APC-00775014
APC-00775107
APC-00775206
APC-00775243
APC-00775465
APC-00775502
APC-00775517
APC-00775633
APC-00775866
APC-00775892
APC-00775926
APC-00776181
APC-00776400
APC-00776406
APC-00776506
APC-00776775
APC-00777028
APC-00777034
APC-00777235
APC-00777329
APC-00777428
APC-00777528
APC-00777567
APC-00777611
APC-00777809
APC-00778050
APC-00778059
APC-00778075
APC-00778093
APC-00778123
APC-00778129
APC-00778263
APC-00778824
APC-00779065
APC-00779449
APC-00779469
APC-00779479
APC-00779578
APC-00780285
APC-00780289
APC-00780408
APC-00780418
APC-00780428
APC-00780449

APC-00781025
APC-00781236
APC-00781345
APC-00781455
APC-00781459
APC-00782108
APC-00782124
APC-00782136
APC-00782162
APC-00782204
APC-00782215
APC-00782330
APC-00783560
APC-00783757
APC-00784849
APC-00784868
APC-00784888
APC-00784918
APC-00784922
APC-00785122
APC-00785266
APC-00785301
APC-00785303
APC-00785868
APC-00785882
APC-00786056
APC-00786209
APC-00786241
APC-00786269
APC-00786285
APC-00786817
APC-00787155
APC-00787246
APC-00787342
APC-00787898
APC-00787943
APC-00787955
APC-00788457
APC-00788472
APC-00788515
APC-00789146
APC-00789245
APC-00789317
APC-00790225

APC-00790250
APC-00790664
APC-00790771
APC-00790793
APC-00790956
APC-00790975
APC-00790987
APC-00790994
APC-00791188
APC-00825104
APC-01170568
APC-01227135
APC-01323609
APC-01333637
APC-01340182
APC-01340189
APC-01340190
APC-01381739
APC-01413339
APC-01413845
APC-01433117
APC-01433355
APC-01439197
APC-01452536
APC-01549864
APC-01678952
APC-01716332
APC-01720982
APC-01721074
APC-01721174
APC-01721804
APC-01721899
APC-01723224
APC-01723384
APC-01723477
APC-01723568
APC-01723659
APC-01723761
APC-01723863
APC-01723999
APC-01724000
APC-01724002
APC-01724214
APC-01724426

APC-01725455
APC-01725562
APC-01725797
APC-01726188
APC-01726402
APC-01727482
APC-01727485
APC-01727486
JanHen_00005019
JanHen_00035898

SEC Filings

Anadarko Petroleum Corporation DEFM14A (Merger Proxy) Statement filed July 11, 2019
Anadarko Petroleum Corporation DEF 14A (Proxy) Statement filed March 29, 2019
Anadarko Petroleum Corporation DEF 14A (Proxy) Statement filed March 23, 2018
Anadarko Petroleum Corporation DEF 14A (Proxy) Statement filed March 17, 2017
Anadarko Petroleum Corporation DEF 14A (Proxy) Statement filed March 18, 2016
Anadarko Petroleum Corporation DEF 14A (Proxy) Statement filed March 23, 2015
Anadarko Petroleum Corporation DEF 14A (Proxy) Statement filed March 21, 2014
Anadarko Petroleum Corporation DEF 14A (Proxy) Statement filed March 25, 2013
Anadarko Petroleum Corporation DEF 14A (Proxy) Statement filed March 23, 2012
Anadarko Petroleum Corporation DEF 14A (Proxy) Statement filed March 25, 2011
Anadarko Petroleum Corporation DEF 14A (Proxy) Statement filed March 26, 2010
Anadarko Petroleum Corporation DEF 14A (Proxy) Statement filed March 29, 2009
Anadarko Petroleum Corporation DEF 14A (Proxy) Statement filed March 31, 2008
Anadarko Petroleum Corporation DEF 14A (Proxy) Statement filed March 27, 2007

Anadarko Petroleum Corporation Form 10-K filed February 14, 2019
Anadarko Petroleum Corporation Form 10-K filed February 15, 2018
Anadarko Petroleum Corporation Form 10-K filed February 15, 2017
Anadarko Petroleum Corporation Form 10-K filed February 17, 2016
Anadarko Petroleum Corporation Form 10-K filed February 20, 2015
Anadarko Petroleum Corporation Form 10-K filed February 28, 2014
Anadarko Petroleum Corporation Form 10-K filed February 19, 2013
Anadarko Petroleum Corporation Form 10-K filed February 21, 2012
Anadarko Petroleum Corporation Form 10-K filed February 23, 2011
Anadarko Petroleum Corporation Form 10-K filed February 23, 2010

Anadarko Petroleum Corporation Form 10-Q filed July 30, 2019
Anadarko Petroleum Corporation Form 10-Q filed May 8, 2019
Anadarko Petroleum Corporation Form 10-Q filed October 30, 2018
Anadarko Petroleum Corporation Form 10-Q filed July 31, 2018
Anadarko Petroleum Corporation Form 10-Q filed May 1, 2018
Anadarko Petroleum Corporation Form 10-Q filed October 31, 2017

Anadarko Petroleum Corporation Form 10-Q filed July 24, 2017
Anadarko Petroleum Corporation Form 10-Q filed May 2, 2017
Anadarko Petroleum Corporation Form 10-Q filed October 31, 2016
Anadarko Petroleum Corporation Form 10-Q filed July 26, 2016
Anadarko Petroleum Corporation Form 10-Q filed May 2, 2016
Anadarko Petroleum Corporation Form 10-Q filed October 27, 2015
Anadarko Petroleum Corporation Form 10-Q filed July 28, 2015
Anadarko Petroleum Corporation Form 10-Q filed May 4, 2015
Anadarko Petroleum Corporation Form 10-Q filed October 28, 2014
Anadarko Petroleum Corporation Form 10-Q filed July 29, 2014
Anadarko Petroleum Corporation Form 10-Q filed May 5, 2014

ConocoPhillips DEF 14A (Proxy) Statement filed March 30, 2020
EOG Resources, Inc. DEF 14A filed March 15, 2018

Robert P. Daniels Form 4 filed November 7, 2016
Robert P. Daniels Form 4 filed October 27, 2016
Robert P. Daniels Form 4 filed November 9, 2015
Robert P. Daniels Form 4 filed October 28, 2015
Robert P. Daniels Form 4 filed October 16, 2015
Robert P. Daniels Form 4 filed March 24, 2015
Robert P. Daniels Form 4 filed November 10, 2014
Robert P. Daniels Form 4 filed November 6, 2014
Robert P. Daniels Form 4 filed May 22, 2014
Robert P. Daniels Form 4 filed April 11, 2014
Robert P. Daniels Form 4 filed November 12, 2013
Robert P. Daniels Form 4 filed November 7, 2013
Robert P. Daniels Form 4 filed July 3, 2013
Robert P. Daniels Form 4 filed February 13, 2013
Robert P. Daniels Form 4 filed November 13, 2012
Robert P. Daniels Form 4 filed November 7, 2012
Robert P. Daniels Form 4 filed March 16, 2012
Robert P. Daniels Form 4 filed December 2, 2011
Robert P. Daniels Form 4 filed November 14, 2011
Robert P. Daniels Form 4 filed November 10, 2011

R. A. Walker Form 4 filed August 9, 2019
R. A. Walker Form 4 filed November 16, 2018
R. A. Walker Form 4 filed November 14, 2018
R. A. Walker Form 4 filed October 30, 2018
R. A. Walker Form 4 filed November 16, 2017
R. A. Walker Form 4 filed November 14, 2017
R. A. Walker Form 4 filed November 8, 2017
R. A. Walker Form 4 filed October 30, 2017
R. A. Walker Form 4 filed May 17, 2017
R. A. Walker Form 4 filed November 15, 2016

R. A. Walker Form 4 filed November 7, 2016
R. A. Walker Form 4 filed October 27, 2016
R. A. Walker Form 4 filed November 9, 2015
R. A. Walker Form 4 filed October 28, 2015
R. A. Walker Form 4 filed May 19, 2015
R. A. Walker Form 4 filed November 10, 2014
R. A. Walker Form 4 filed November 6, 2014
R. A. Walker Form 4 filed August 8, 2014
R. A. Walker Form 4 filed May 16, 2014
R. A. Walker Form 4 filed November 15, 2013

Robert G. Gwin Form 4 filed August 9, 2019
Robert G. Gwin Form 4 filed November 16, 2018
Robert G. Gwin Form 4 filed November 14, 2018
Robert G. Gwin Form 4 filed October 30, 2018
Robert G. Gwin Form 4 filed November 16, 2017
Robert G. Gwin Form 4 filed November 14, 2017
Robert G. Gwin Form 4 filed November 8, 2017
Robert G. Gwin Form 4 filed October 30, 2017
Robert G. Gwin Form 4 filed November 15, 2016
Robert G. Gwin Form 4 filed November 7, 2016
Robert G. Gwin Form 4 filed October 27, 2016
Robert G. Gwin Form 4 filed March 2, 2016
Robert G. Gwin Form 4 filed November 9, 2015
Robert G. Gwin Form 4 filed October 28, 2015
Robert G. Gwin Form 4 filed October 9, 2015
Robert G. Gwin Form 4 filed November 10, 2014
Robert G. Gwin Form 4 filed November 6, 2014
Robert G. Gwin Form 4 filed August 8, 2014
Robert G. Gwin Form 4 filed November 21, 2013

Ernest A. Leyendecker III Form 4 filed June 5, 2018
Ernest A. Leyendecker III Form 4 filed November 16, 2017
Ernest A. Leyendecker III Form 4 filed November 14, 2017
Ernest A. Leyendecker III Form 4 filed November 8, 2017
Ernest A. Leyendecker III Form 4 filed October 30, 2017
Ernest A. Leyendecker III Form 4 filed November 15, 2016
Ernest A. Leyendecker III Form 4 filed November 7, 2016
Ernest A. Leyendecker III Form 4 filed October 27, 2016
Ernest A. Leyendecker III Form 3 filed September 1, 2016

Other Documents

Agrawal, Anup, and Tommy Cooper, "Insider Trading Before Accounting Scandals," *Journal of Corporate Finance*, Vol. 34 (2015): 169-190

Agrawal, Anup, and Tareque Nasser, “Insider Trading in Takeover Targets,” *Journal of Corporate Finance*, Vol. 18 (2012): 598-625

Aitken, Michael, Douglas Cumming, and Feng Zhan, “Exchange Trading Rules, Surveillance and Suspected Insider Trading,” *Journal of Corporate Finance*, Vol. 34 (2015): 311-330

Bettis, J. C., J.L. Coles, and M. L. Lemmon, “Corporate Policies Restricting Trading by Insiders,” *Journal of Financial Economics*, Vol. 57 (2000): 191-220

Fishman, Michael J., and Kathleen M. Hagerty, “Insider Trading and the Efficiency of Stock Prices,” *RAND Journal of Economics*, Vol. 23, No. 1 (Spring 1992): 106-122

Hillier, David, Adriana Korczak, and Pitor Korczak, “The Impact of Personal Attributes on Corporate Insider Trading,” *Journal of Corporate Finance*, Vol. 30 (2015): 150-167

Jagolinzer, Alan D., David F. Larcker, and Daniel J. Taylor, “Corporate Governance and the Information Content of Insider Trades,” *Journal of Accounting Research*, Vol. 49, No. 5 (December 2011): 1249-1274

Kraft, Anastasia, Bong Soo Lee, and Kerstin Lopatta, “Management Earnings Forecasts, Insider Trading, and Information Asymmetry,” *Journal of Corporate Finance*, Vol. 26 (2014): 96-123

Lee, Inmoo, Michael Lemmon, Yan Li, and John M. Sequeira, “Do Voluntary Corporate Restrictions on Insider Trading Eliminate Informed Insider Trading?” *Journal of Corporate Finance*, Vol. 29 (2014): 158-178

Murphy, Kevin J., “Corporate Performance and Managerial Remuneration: An Empirical Analysis,” *Journal of Accounting and Economics*, Vol. 7 (April 1985): 11-42

Master Glossary – Proved Oil and Gas Reserves, Financial Accounting Foundation, 2022

Seyhun, H. Nejat, “Insiders’ Profits, Costs of Trading, and Market Efficiency,” *Journal of Financial Economics*, Vol. 16 (1986): 189-212

Data Sources

Bloomberg, L.P.

2022 Center for Research in Security Prices (CRSP), The University of Chicago Booth School of Business